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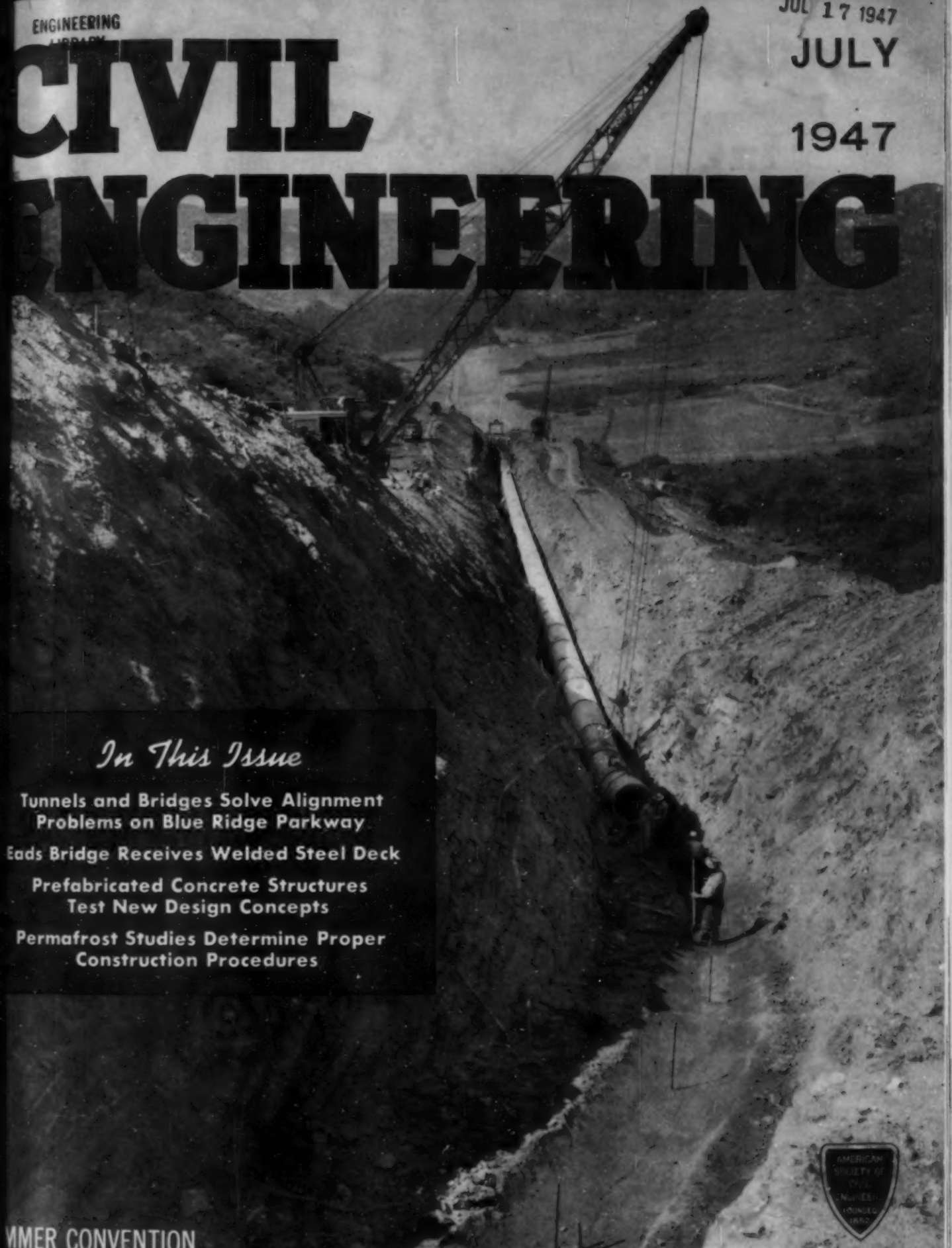

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Tunnels and Bridges Solve Alignment Problems on Blue Ridge Parkway

Eads Bridge Receives Welded Steel Deck

Prefabricated Concrete Structures Test New Design Concepts

Permafrost Studies Determine Proper Construction Procedures

MMER CONVENTION
DULUTH, MINN.
ULY 16-18, 1947

CRAWLER CRANE, 30-ton capacity at 20-ft radius, places 72-in. concrete pipe to maximum depth of 32 ft on Navy-built San Diego Aqueduct. See story page 14.

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JULY 1947
Volume 17 Number 7

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Original Woodcut by Lynd Ward

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Constitutional Amendments and Technical Sessions Share Spotlight

at Seventy-Fifth Annual Convention Duluth, Minn., July 16-18, 1947

DISCUSSION OF the interrelated proposed Constitutional Amendments (1) to enfranchise Juniors and (2) to increase Society dues, will share the spotlight with the technical sessions being arranged for the ASCE's Seventy-fifth Annual Convention in Duluth, July 16–18. The amendments will be sent to ballot this fall in the form decided upon at the Duluth business meeting. Since the results of that balloting are expected to have a marked effect on the policies the Society will pursue in the future, interest in the proposed amendments is running high.

Recently there was mailed from the national headquarters of the Society a circular, informing all corporate members of the exact wording by which it is proposed to amend the Constitution. At the same time, corporate members were advised of the decision of the Board of Direction, reached at the Spring Meeting in Phoenix, to offer an amendment to the proposed amendments, to provide that dues for all Juniors shall be $12.50 annually, eliminating a $5 differential that has existed against Juniors in the Metropolitan district.

The Convention will open on Wednesday morning, July 16, with the President's Annual Address and two short papers on Minnesota's iron and timber resources, followed by a business session at which the above mentioned proposed constitutional amendments will be presented. To follow the business session, members of the Duluth Local Section, smallest among the Society's 66 Sections, have arranged technical and entertainment sessions designed to please the 500 or more they expect will attend. Many members and their families will attend en route to vacations in Minnesota's famed 10,000 lakes vacation country.

The Program of the Annual Convention was printed in the June issue of CIVIL ENGINEERING and a summary program and registration card have been mailed to some 5,000 members in 23 of the Local Sections from which most of the attendance at Duluth will be drawn.

Technical Division sessions scheduled for Wednesday afternoon and Thursday, July 17, are, with number of sessions: Construction (2), Power (1), Waterways (2), Highway (1), Hydraulics (2), Structural (1), and Sanitary Engineering (1). On Friday, July 18, an all-day trip by bus will be made to the famed open-pit iron mines near Hibbing, Minn.

Early Hotel Reservations Are Important. Members, planning to attend the Convention, who have not requested hotel reservations should do so at once as hotel space will be at a premium. Reservations should be made by writing to John L. Pickles, Chairman, Hotel and Registration Committee, c/o Chamber of Commerce, Medical Arts Bldg., Duluth 2, Minn.

GIANT FREIGHTERS CARRY YEARLY AVERAGE of 48,000,000 tons of iron ore from Duluth and Head-of-the-Lakes to blast furnaces and steel mills of lower lake ports. Some 85 percent of America's total iron-ore production comes from mines in Lake Superior District, most of which is from great Minnesota iron ore deposits of Vermilion, Cuyuna and Mesabi Iron Ranges north of Duluth. Port of Duluth is one of America's busiest centers of commerce and is second only to New York in annual shipping tonnage.

VIEW OF DULUTH'S DOWNTOWN DISTRICT from Skyline Boulevard includes Minnesota Point, harbor entrance with unique aerial lift bridge, Lake Superior and Wisconsin shoreline in distance. Duluth's Skyline Boulevard is internationally famous as one of world's most magnificent drives. Scenic beauties, together with cool, invigorating climate seldom exceeding temperature of 80 deg, and variety of recreational facilities, are making this northern city one of America's favorite summer playgrounds.

ENOUGH REINFORCED CONCRETE PIPE to build 40 miles of San Diego Aqueduct—approximately 180,000 tons—is hauled from plant to site by trailers. Fleet of 200 Fruehauls is owned by United Concrete Pipe Corp., contractor on section between San Jacinto and San Diego.

Navy-Constructed Aqueduct

Supplies Colorado River Water to City of San Diego

R. D. THORSON, M. ASCE

Commander CEC, USN; Resident Officer-in-Charge, San Diego Aqueduct Project

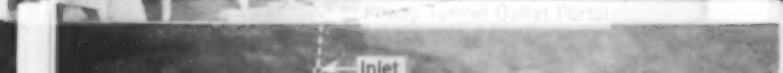
CONSTRUCTION OF the 71.1-mile San Diego Aqueduct, from San Jacinto to the impounding reservoir of the San Diego City System, was originally planned by the Navy as a wartime emergency project to supply the demands of huge naval and military installations and vital war industries in the San Diego area. Recognizing the continuing requirements of the military and naval establishments in the San Diego zone after V-J Day, the Navy agreed to proceed with the construction of the $12,500,000 project in accordance with the provisions of its contract with the San Diego County Water Authority.

WATER SUPPLY for the city of San Diego is at present derived from three principal drainage basins, all located in the southwest corner of the state. A study of past rainfall records indicates clearly that the southern coastal portion of the state is subject to wet and dry periods of approximately ten-year duration. The San Diego area is no exception. Streams located within this area are variable and flashy in nature.

REINFORCING STEEL CAGES (left) are placed on inside forms. Pipe forms consist of steel jackets 12 ft long for 96-in.-dia pipe and 16 ft long for pipe sizes of 48, 54 and 72 in. Stripped pipe in background is ready for removal from inner form.

LONGITUDINAL BARS are tack-welded to vertical rings in manufacture of precast concrete pipe at United Concrete Pipe Corp's. Baldwin Park, Calif., plant. Pipe manufacturing methods are essentially same at each plant. Inside and outside pipe reinforcing steel cages are mechanically fabricated by wrapping rod reinforcement on revolving cylindrical form.

CONCRETE IS POURED into forms for 48-in. pipe by means of crane and bottom-dump bucket of 1-cu yd capacity. Pipe wall thickness varies from 5 3/4 in. for 48-in.-dia pipe to 9 in. for 96-in.-dia pipe. All cast pipe is given either 72-hour moist steam cure or 36-hour moist steam cure followed by 7-day continuous water spray cure on inside and outside surfaces.



The city of San Diego has constructed a series of impounding reservoirs in which to retain these periodic flash floods. As water consumption has increased in recent years, considerable anxiety has been felt by San Diego water authorities over the adequacy and dependability of their present system. Approximately ten years of overabundant rainfall temporarily satisfied the increased demand and deferred the need for an adequate unfailing supply.

The only dependable and adequate source of water supply available to this area is the Colorado River. Because the federal government is the largest single consumer in the San Diego area, and will continue to be a heavy consumer, it was only natural that the Federal Works Agency and the Bureau of Reclamation should be delegated to investigate, with the city, the most feasible means by which San Diego could augment its present supply with Colorado River water.

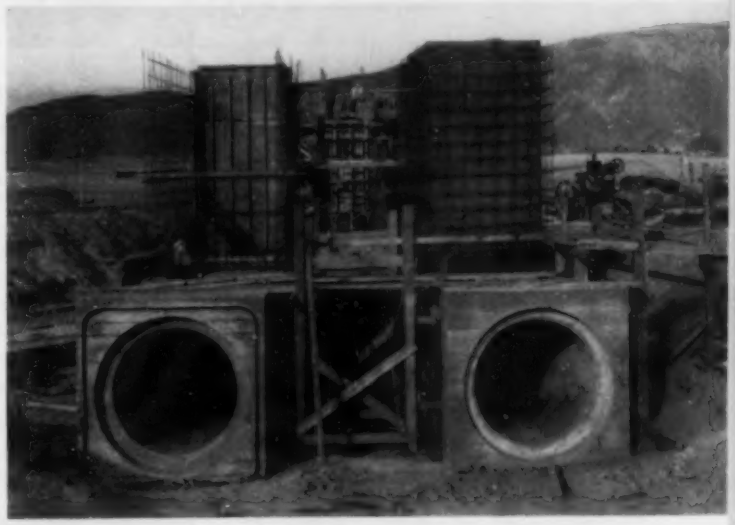
As a result of these studies, it was determined that the most expedient method of obtaining Colorado River water was to construct a 71.1-mile link between the Metropolitan Water District system, at San Jacinto, Calif., and the San Vicente Reservoir. This link, while somewhat longer than a possible connection with the All-American Canal system near Kane Springs, Calif., was an all gravity-flow line, requiring minimum use of critical war materials; did not require the construction of long tunnels or the use of heavy electrical pumping equipment; and could be constructed within a two-year period.

As rainfall trends indicated the possible approach of a dry period similar to that which occurred in 1897 and continued until 1904, during which little or no runoff occurred, the Bureau of Reclamation rushed the preparation of plans to early completion, and the first contract was awarded by the Navy Department on May 18, 1945.

San Diego to Reimburse Federal Government

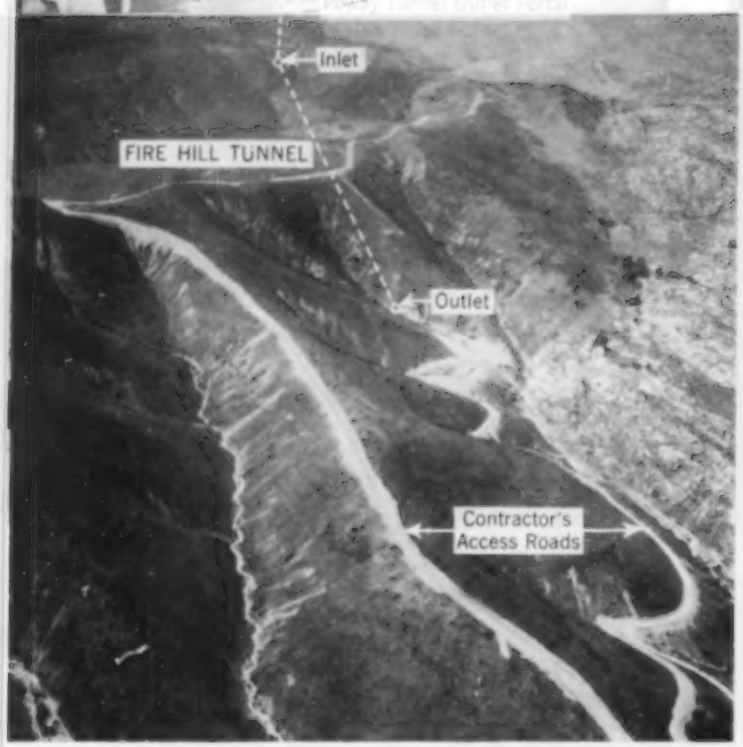
On June 9, 1944, the San Diego County Water Authority was organized for the purpose of bringing Colorado River water into the county and distributing it to its eight member public agencies. Under the present revised and broader program, the San Diego County Water Authority will undertake to construct additional distributing facilities with which to provide service to the local municipalities and the utility and irrigation districts comprising its membership.

SAN JACINTO RIVER crossing, consisting of 500 ft of 96-in. monolithic concrete conduit, is connected with diversion structure at northern terminus of aqueduct by 900 ft of 96-in.-dia precast concrete pipe.



RESERVOIR OUTLET, reinforced concrete structure at northern terminus of aqueduct near San Jacinto, is part of diversion structure which comprises inlet works and actual physical connection to Metropolitan Water District system.

STEEL PIPE, 48-in. dia, is used for siphons at Couser Canyon, San Dieguito and San Luis Rey Canyon, pictured here (right), where operating heads exceed 500 ft and reach maximum of 930 ft. Bell and spigot welds are made in field and pneumatically tested in place. Rainbow Tunnel, near inlet portal (below) is ready for concrete lining operations. Pneumatic and pump-type concrete placing equipment is used in lining operations.



RUGGED TERRAIN along route of aqueduct is seen in aerial view (left) of 5,700-ft Fire Hill Tunnel location. Winding road constructed by contractor is access to tunnel outlet portal (above). Steel-rib supports of 4-in., 13.8-lb H-beams are lagged with 2-in. planking.

On the 17th of October 1945, the City of San Diego had entered into a contract with the Navy Department to reimburse the Federal Government annually at the rate of $500,000, until the true costs of the aqueduct would have been repaid. Under the provisions of this contract, the Government is to retain possession until the last payment is made, at which time the ownership would rest with the city.

However, on November 5, 1946, the voters of the City of San Diego voted by a 12 to 1 majority to modify the City-Navy aqueduct contract so as to transfer to the newly created San Diego County Water Authority the repayment contract and eventual ownership of the aqueduct. In this same election the people of the City of San Diego voted to transfer their Colorado River water rights to the Metropolitan Water District. At the same time the voters of the San Diego County Water Authority voted to become a member agency of the Metropolitan Water District.

As a result of this successful election, all legal entanglements for the delivery of Colorado River water to the peoples and lands of San Diego County were cleared away.

Tunnels Designed for Full Capacity

The capacity of the aqueduct was designed to deliver initially half the amount of the 112,000 acre-ft yearly storage in Lake Meade allocated to the City of San Diego, as provided under the contract approved by the Secretary of the Interior on February 15, 1933. Provision was made in the original design of the aqueduct for increasing the delivery to full capacity, whenever the demand warranted, by the installation of a second parallel pipeline between the reservoir and tunnels. The tunnels are being initially constructed to full ultimate capacity.

By diverting a portion of the delivery en route, taking advantage of the excess tunnel capacity provided to allow for possible emergency repairs and breakdowns, and installing a larger parallel line, it may in the future prove practical to increase the carrying capacity, thereby providing greater utility value than was originally designed.

REGULATING RESERVOIR of 1,850 acre-ft capacity is in relatively level area two miles from diversion structure at outlet of San Jacinto Tunnel. Adequate equipment permitted completion of rolled earthfill construction in minimum amount of time during winter months of 1945–1946.

WAGON DRILLS PREPARE holes for blasting trench on high section of aqueduct at Mile 50.9. Alinement controls originally established by Bureau of Reclamation for their final location are used by Navy survey crews in establishing line and grade.

BACKHOES, of $1^1/_2$- and $2^1/_2$-cu yd capacities, proved rapid and efficient in excavating trench to average depth of about 12 ft through alluvial valleys and decomposed granite areas strewn with hard granite boulders, rocky part of which required blasting.

As the Metropolitan Water District's system is at this time only operated intermittently, and the minimum capacity of one of its pumping stations is 200 cfs, it was necessary to construct an earthfill reservoir of 1,400 acre-ft capacity, two miles south of the junction of the two systems, and connect it with a supply line of 200-cfs capacity, in order to obtain, for the remainder of the line, the continuous delivery of 85 cfs for a maximum period of eight days. Electrically operated gates provide automatic operation and uniform flow, regardless of the elevation of the water in the reservoir. When the demand on the metropolitan system develops to the point where its facilities are operated continuously, the use of the regulating reservoir will no longer be required.

Diversion Structure of Reinforced Concrete

The San Diego Aqueduct's northern terminus is near San Jacinto, Calif. A reinforced concrete diversion structure, with control gates, a venturi section, and an operator's house containing the measuring and recording instruments, comprises the inlet works and actual physical connection to the Metropolitan Water District system, at the west portal of its San Jacinto Tunnel. Approximately 900 ft of 96-in.-dia precast concrete pipe connects this structure with the San Jacinto River crossing, consisting of 500 ft of monolithic concrete conduit, of similar cross-section. From the river crossing to the reservoir, the aqueduct consists of 96-in.-dia precast concrete pipe.

ESTIMATED QUANTITIES FOR TOTAL PROJECT

Excavation	2,850,000 cu yd
Backfill	2,100,000 cu yd
Riprap	45,000 cu yd
Concrete	135,000 cu yd
Miscellaneous metalwork	306,000 lb
Compacting backfill	114,500 cu yd
Rubber water stops	1,700 lin ft
Chain link fence	15,000 lin ft
Steel, reinforcing and joint rings	27,000 tons
Pipe and fittings	223,000 lb
Nozzles and covers	123,500 lb
48-in. concrete pipe	149,152 lin ft
54-in. concrete pipe	115,088 lin ft
72-in. concrete pipe	64,208 lin ft
96-in. concrete pipe	9,840 lin ft
Steel pipe	9,498 lin ft
Steel rib tunnel supports	290,000 lb
Permanent timbering in tunnels	50,000 b. f.
Dry-rock paving	2,000 sq yd
Cement	185,000 bbl
Cement, sulfate resisting	23,000 bbl

MAXIMUM DEPTH of 32 ft is reached by 3-cu yd draglines in excavating trench for 72-in.-dia pipe. Pipe is laid by 30-ton, 20-ft-radius crawler crane. Pipe foundation, in general, is cut to grade and shaped to fit pipe. Where subgrade is unsuitable it is removed below grade and replaced by selected material, compacted in place. Backfill material is compacted by compressed-air tampers.

All the 96-in.-dia concrete pipe was precast in 12-ft lengths, and hauled to the site in specially built low-bed trucks. The 12-ft sections weighed approximately 19 tons. The trench excavation for the 96-in.-dia conduit averaged about 12 ft in depth, with groundwater encountered approximately 6 ft below the surface. The material excavated was in general a sandy alluvium. Dewatering of the trench was accomplished by the "well-point" method; $2^1/_2$-cu yd draglines were used to excavate the trench, and 30-ton, 20-ft-radius crawler cranes handled the pipe sections in the laying operation. The backfill forming the cradle support for the pipe consisted of a selected coarse clean sand, well jetted, and vibrated into place by the use of concrete vibrators.

Storage and Regulating Reservoir

The regulating reservoir was constructed by enclosing an area of approximately 160 acres with an earthfill dike to a maximum height of 24 ft. The slope of the inside face of the dike is 3:1, and the slope on the outside face is 2:1. The outer and main portion of the dike was constructed by using the sandy material excavated from within the basin area. The inside face was surfaced with a blanket of dense, impervious material, 10 ft in width, excavated from a borrow pit two miles west of the site. The surfaces of these materials were protected by a layer of tunnel muck previously taken from the Metropolitan Water District's San Jacinto Tunnel On the reservoir's inside face, a 2-ft thickness of granite riprap was placed to reduce wave erosion. The entire bottom area of the basin is lined with a 12-in. layer of impervious material, and protected by a 4-in. blanket of sand.

Adequate equipment was provided for construction of the reservoir in a

ELECTRICALLY-DRIVEN ventilating blowers and diesel-operated compressors installed at tunnel portals are capable of producing 350 to 500 cfm at 105-lb pressure. Pictured here is open cut at inlet portal of San Vicente Tunnel.

minimum of time during the winter months of 1945–1946. Tractor-wagons of 12-cu yd capacity hauled and deposited in place the sandy materials; $2^1/_2$-cu yd draglines excavated the impervious material, which was hauled to the site in 12-cu yd dump trucks. The material was leveled to the desired layer thickness by road graders; water-tank trucks provided the necessary additional moisture; scarifiers mixed the material to uniform moisture content; and caterpillar-type tractors, pulling tandem sheepsfoot-type tamper rollers, consolidated the materials to the specified density.

Rock for the riprap face was quarried and hauled from a site about 2 miles from the reservoir. A $2^1/_2$-cu yd shovel loaded the 20-cu yd trucks used in hauling the riprap. Placing of the riprap was done by bulldozer and a $2^1/_2$-cu yd dragline. Water was pumped into the reservoir from a nearby well drilled by the contractor for the purpose of covering the bottom and fully protecting the impervious blanket against drying out before Colorado River water could be obtained.

Samples of the consolidated materials were taken during each shift and whenever the character or moisture content of the material noticeably changed. These samples were immediately tested at a field laboratory on the site; by this method, adequate control was assured. The axes of the dike were marked by large targets outside the work area, and elevation markers were placed on power poles that bordered the reservoir area. These guides proved very helpful to the contractor constructing the reservoir embankment, and aided in inspection of the work.

The outlet works consists of trash racks, Venturi meter, gate structures, and an operator's house containing the flow meter and recording instruments. The impounded water leaves the outlet works by gravity flow, through a 72-in.-dia, precast concrete pipe conduit; thence through 54-in.-dia and 48-in.-dia pipe, depending on the grade of the invert and hydraulic gradient. All 48-, 54-, and 72-in.-dia pipe sections were manufactured in 16-ft lengths, and hauled to the site on trucks and trailers.

Concrete Pipeline

The trench for the 72-in.-dia pipe reached a maximum depth of 32 ft, and generally was through clayey, silty, and sandy alluvium material. This excavation was accomplished by the use of 3-cu yd draglines. The trench for the 54- and 48-in.-dia pipe was, in general, through alluvial valleys and decomposed granite areas strewn with hard granite boulders, the rocky part of which required blasting. The depth of trenching averaged about 12 ft, and excavation was accomplished by the use of $1^1/_2$ and $2^1/_2$-cu yd "backhoes," which proved rapid and efficient in operation. Pipe laying was done with 30-ton, 20-ft-radius crawler cranes.

The pipe foundation was, in general, cut to grade and shaped to fit the pipe, in natural undisturbed material. Where the subgrade material proved to be unsuitable, it was removed below grade, and replaced with satisfactory selected material, compacted into place. The compaction of the material surrounding the pipe was accomplished with the use of compressed-air tampers, consolidating a moisture-controlled material to the required density. In some sandy areas, where water was available, the backfill was jetted and vibrated with concrete vibrators, producing the specified density more readily. As the specifications required rigid adherence to the density requirements, samples of the backfill were constantly checked in the field laboratory.

Groundwater, where encountered, was controlled either by excavating below grade and replacing with crushed gravel, or by constructing a side ditch along the bottom of the trench, draining to a sump, and dewatering by mechanical pumping; or it was removed by the use of a "well-point" system.

Backfill over the pipe above the compacted area was accomplished by "puddling" in layers to the ground surface. In this operation $1^1/_2$-cu yd draglines, bulldozers, carryalls, road graders, sheepsfoot rollers, weighted lumber carriers, and mechanical tampers, were used at times.

Steel Siphons Used in Three Locations

At the San Luis Rey, Couser Canyon, and San Dieguito siphons, where the operating heads exceed 500 ft, and reach a maximum of 930 ft, 48-in.-dia steel pipe, with a minimum plate thicknes of $^7/_{16}$ in. and a maximum plate thickness of $^{13}/_{16}$ in., was used to withstand the heavy pressures. The steel pipe was fabricated in 30-ft sections and each section was hydrostatically tested in the shop before being trucked to the job site. Bell and spigot welds were made in the field, and pneumatically tested in place. No expansion joints were required, because the steel pipe is entirely backfilled, and anchored in place with heavy concrete anchor blocks at approximately 200-ft intervals.

All steel pipe received an inside lining and an outside coating of coal-tar pitch enamel in the shop. Both the interior and exterior enamel surfaces were checked for flaws with an electric flaw detector, and subjected to a "peel" test. All steel pipe received a $^3/_4$-in. protective external coating of "Gunite," applied in two layers. Wire-mesh reinforcement was placed over the first Gunite layer. On steep grades, the pipe sections were transported and placed in the excavated trench by the use of side-boom tractors.

"Well-points" were used to keep the trench in the river bottoms dry. The surface flow was either diverted around or carried over the pipe trench in metal pipe. Rough trench excavation was accomplished by the use of a 2-cu yd dragline. Fine grading and shaping of the bottom of the trench was done by hand. Pipe backfill consisted in general of a sandy material, jetted and vibrated into place.

Tunnels of Horseshoe-Shaped Cross Section

The San Diego Aqueduct contains seven concrete-lined, 6-ft-dia tunnels of horseshoe-shaped cross-section, all designed to convey a maximum of 165 cfs, or 100 mgd, under free-flow conditions. See Table I.

The character of the material en-

countered at the Rainbow, Red Mountain, Oat Hills, Poway, Lilac, and San Vicente Tunnels was hard blocky granite requiring no supports. At the Fire Hill Tunnel, the material consisted of an alluvial conglomerate, of well-rounded, partially cemented boulders, gravel, sand, and clay, for the south 3,600 ft, where supports were required. Beyond a distance of 3,600 ft from the downstream portal, the heading is completely in hard granite.

Steel-rib supports, forming a Gothic-shaped arch, and fabricated from 4-in., 13.8-lb H-beams, were installed and lagged with 2-in. planking, wherever permanent tunnel support was required. Very little groundwater was encountered in any of the tunnels, and little grouting will be required.

Tunnel Excavating Equipment

The equipment installed at the tunnel portals for the excavating operations includes diesel-driven generators, electrically-driven ventilating blowers, and diesel-operated compressors capable of producing air at 350 to 500 cfm, at 105-lb pressure. Fresh air was blown into the heading at approximately 2,000 cfm through 10-in. steel pipes.

Muck trains consisting of ten $2^1/_2$-cu yd side-dump muck cars, and seven 1-cu yd tipover-type cars, were pulled by battery-powered locomotives along 24-in.-gage tracks of 30-lb rails, laid on an approximately flat grade. Air-operated mucking machines were used for loading.

Three automatic feed drills, mounted on radial arms, pivoting and extending from the front end of a special flatcar, or mounted on arms clamped to two vertical columns supported by a flatcar and wedged tightly against the roof of the tunnel, were used for drilling the heading. The tunnel crew at each tunnel location normally consists of 17 men per shift.

For blasting each round where hard-rock material was encountered, 25 to 27 holes were drilled to a depth of 6 ft, and loaded with approximately 115 lb of 60 percent gelatin dynamite. In the softer material, good results were obtained with only 12 holes 7 ft deep, loaded with 60 lb of 60 percent gelatin dynamite.

Tunnel Concreting Equipment

The placing of the concrete tunnel lining was accomplished through the use of both the "Pumpcrete" and the "Kemper" concrete tunnel lining placing equipment. The recently developed Kemper gun was used in connection with the lining of four of the seven tunnels.

TABLE I. TUNNEL EXCAVATION DATA

Tunnel	Length, Ft	Excavation Begun	Excavation Completed	Average Weekly Progress, Ft
Rainbow	4,694	Jan. 30, '46	Oct. 15, '46	126.86
Lilac	500	Apr. 11, '47	May. 13, '47	108.69
Red Mountain	3,053	Feb. 5, '46	July 27, '46	124.11
Oat Hills	3,590	June 25, '46	Mar. 12, '47	96.76
Poway	3,180	Aug. 5, '46	Mar. 22, '47	97.25
Fire Hill	5,350	Feb. 7, '46	Jan. 11, '47	110.54
San Vicente	2,455	Dec. 17, '45	July 7, '46	84.66

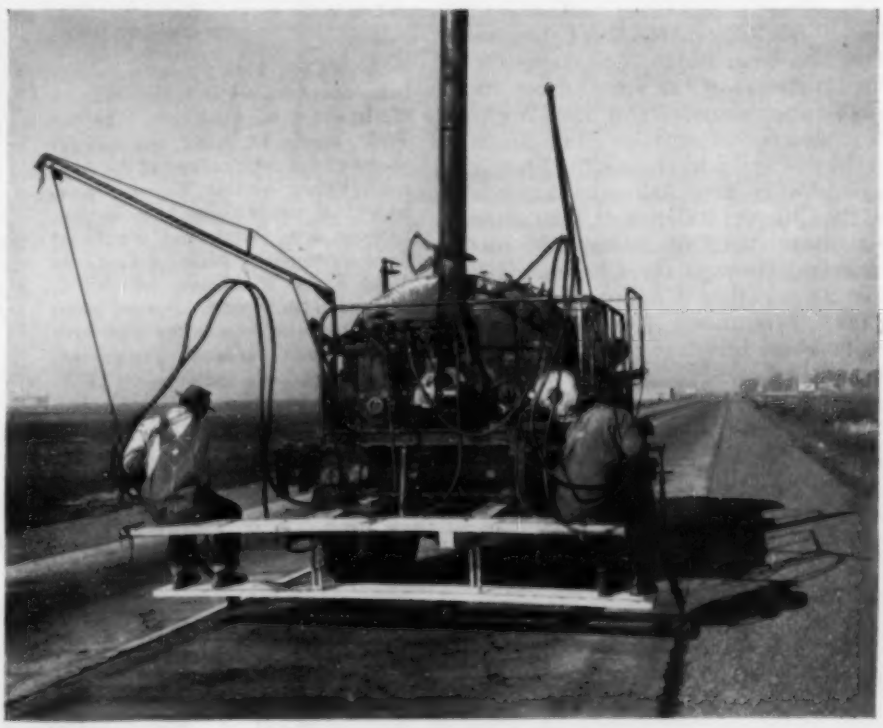
The Kemper placer consists of a semi-spherical metal tank approximately 4 ft in diameter, mounted on a car traveling on the 24-in.-gage track. The placer holds a 1-cu yd batch of concrete and is charged through a 20-in. opening in the top fitted with an air-tight cover.

The principal feature of this new-type Kemper placer is the turnip-shaped needle valve located on the bottom of the tank. The valve is designed to disseminate air through the entire charge of concrete as it drops into the valve chamber, thus preventing formation of large air pockets which cause objectionable segregation. Each placer is also equipped with tapered fittings, air-control valves and patented couplings which greatly facilitate and speed up placing operations.

Groups of three 1-cu yd placers were used in the arch lining operations. A battery-driven locomotive is used to transfer the placers to and from the concrete batching plant stationed at the tunnel portal. Compressed air for operating the con-

(*Continued on page 78*)

Joint Sealing Technique Cuts Costs



JOINT SEALING TECHNIQUE developed by California Division of Highways speeds operation that insures longer service life to concrete pavements. Full circulating metal-covered hose and nozzle assemblies on 940-gal tank permit simultaneous filling of center longitudinal joint and joint along pavement edge. Return trip is necessary to fill opposite pavement edge. Hand-filling of longitudinal joints averaged $14.30 per joint-mile as compared with $8.25 per joint-mile by tank and special equipment.

Tunnels and Bridges Solve

Difficult Location Problems on 476-Mile Blue Ridge Parkway

H. J. SPELMAN, M. ASCE

Division Engineer, Public Roads Administration, Arlington, Va.

UNDOUBTEDLY THE LONGEST parkway in the country and the longest and highest mountain road east of the Mississippi, the Blue Ridge Parkway connects the Shenandoah and Great Smoky Mountains National Parks, a distance of 476 miles. With the Skyline Drive in the Shenandoah Park, it will provide a 573-mile scenic route from Front Royal, Va., to Cherokee, N.C. Mountain roads usually carry traffic over and through the mountains to connect population centers, but the Blue Ridge Parkway will carry traffic along mountain ridges at a high altitude where the traveler will have the advantage of a delightful climate that provides relief from the summer heat. Except for stream crossings at the James, Roanoke and French Broad Rivers, the parkway does not drop below 2,000 ft. Nearly all of the route is above 3,000 ft and in the sections near Mt. Mitchell and on the Pisgah Ridge it rises above 5,000 ft.

BLUE RIDGE PARKWAY lies on or in the Blue Ridge Mountains for three quarters of the length from its northern terminus. Near Mt. Mitchell it descends from the Blue Ridge on the western side, crosses the French Broad Valley near Asheville, ascends to the Pisgah Ridge and continues along it into the Plott Balsaam Mountains and through the Cherokee Indian Reservation to end in the Great Smoky Mountains National Park. In its whole length it passes through no cities or villages, but runs within 4 miles of both Roanoke and Asheville and touches the edge of Blowing Rock, N.C.

ALL WORK ON the parkway has been under the writer's supervision as district and division engineer. The late W. M. Austin, M. ASCE, was in direct charge of the principal part of the work until 1940. The late William I. Lee, M. ASCE, was in charge of the section between Mt. Pisgah and the Great Smoky Mountains National Park. In 1940 E. G. Middleton, M. ASCE, succeeded Mr. Austin. Among others associated with them in the work have been Albert Haygard, Assoc. M. ASCE, S. L. von Gemmingen, G. Y. Carpenter, F. L. Brownell, B. Cottrell, and A. K. Haxstun.

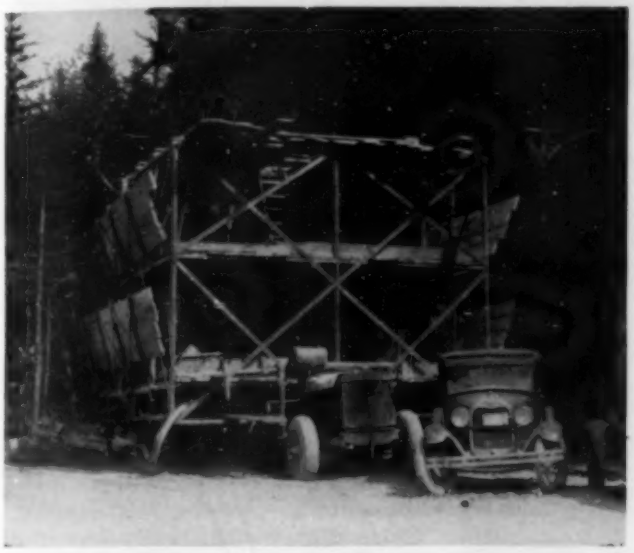
Few roads have presented such an amazing variety of location problems. The terrain varies from gentle to the most rugged in which road construction has been undertaken east of the Mississippi. This wide difference in terrain is illustrated by the fact that out of 40 completed grading and base contracts, the lowest cost per mile was $21,921 on one 11-mile contract, and the highest was $151,463 per mile on a $2\frac{1}{2}$-mile contract.

In the entire distance covered by the Blue Ridge Mountains, from Harpers Ferry to northern Georgia, only the James and Roanoke Rivers break through the ridge. This fact permitted the location of the parkway at high altitudes. North of the Roanoke the Blue Ridge rises abruptly from plains on both sides. South of the Roanoke, for more than 100 miles, the same abrupt escarpment lies to the east, but from the top of the mountain a rolling tableland slopes to the west. This is the area of easiest alignment of the parkway and the lowest construction cost per mile. The most difficult and expensive construction is near Mt. Mitchell, on Pisgah Ridge, and on the approach to the Smokies, not in the Blue Ridge Mountains.

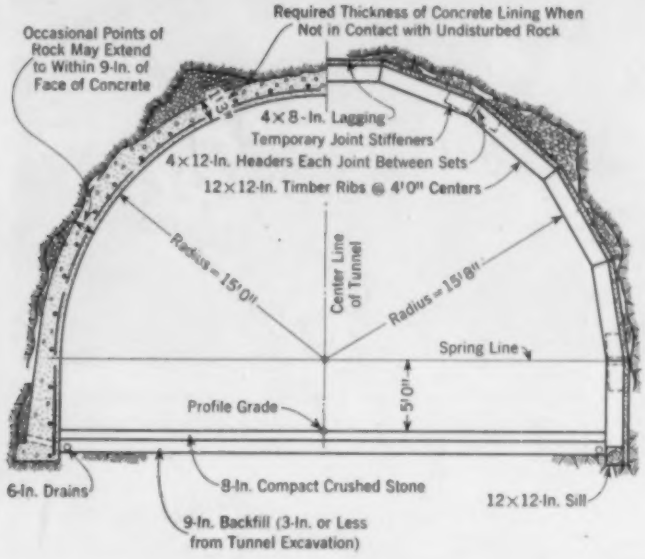
Major stream crossings are planned at the James, the Roanoke and the French Broad Rivers. The only

PIONEER ROAD built by bulldozer (left) provides access for construction of walls, drilling of rock cuts and laying of culverts. Material is hauled to flatter hollows (right) where side hill is too steep for fills to catch. Here Bucyrus-Erie 48-B loads tractor-drawn Euclid wagon with rock and earth for haul to spoil area.

DRIFTER PREPARES CLEAN-UP shot (left) to remove projection and bring tunnel to required cross-section for placing concrete lining. To avoid danger of carbon monoxide in tunnel work, electric shovels (right) are used to load muck. Although ventilating equipment is used, trucks must cut engines while being loaded and must coast down hill where possible.



JUMBO PROVIDES three platforms from which drillers can work. When drilling is complete over entire cross-section jumbo is moved out, face is shot and material removed. Use of this equipment permits entire tunnel section to be taken out in one blasting operation, providing space for power shovel, and eliminating slow hand-loading of old "pioneer cut" method.


Required Thickness of Concrete Lining When Not in Contact with Undisturbed Rock
Occasional Points of Rock May Extend to Within 9-In. of Face of Concrete
4×8-In. Lagging
Temporary Joint Stiffeners
4×12-In. Headers Each Joint Between Sets
12×12-In. Timber Ribs @ 4'0" Centers
Radius = 15'0"
Center Line of Tunnel
Radius = 15'0"
Spring Line
5'0"
Profile Grade
6-In. Drains
8-In. Compact Crushed Stone
12×12-In. Sill
9-In. Backfill (3-In. or Less from Tunnel Excavation)

IN BAD COVER, tunnel is lined with timber against which concrete lining is placed. Where cover is good, concrete lining is placed directly against rock. In either case finished width of tunnel between concrete side walls is 30 ft. Upper part of finished tunnel is true half circle with radius of 15 ft. Spring line is 5 ft above profile grade.

other major stream on the route is the Linville River, which has been crossed by a three-span stone-faced concrete arch, 54 ft above the stream. There will be seven structures over railroads, two of them combined with river crossings. None has yet been built. Two main-line railroads pass deep under the parkway in tunnels.

Location Methods Are Unusual

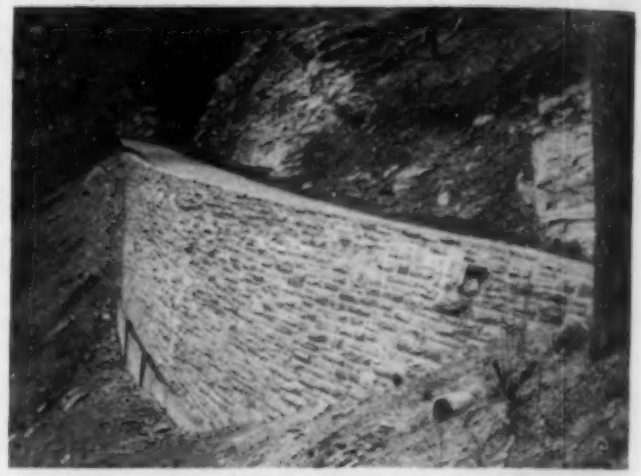
Location methods used are somewhat unusual in highway practice, although common in railroad work. Since the location usually followed a ridge, the primary controls were the gaps or passes in the mountain chain. Normally, selection of location between controls meant making a choice between two sides of the ridge. To obtain the best alignment the location often had to pass from one side of the mountain to the other through any gap which had abrupt or steep sides.

Fortunately, the USGS contour maps were available for all of the route except 50 miles in the tableland south of Roanoke. A thorough study of these maps was made, and a line was projected upon them with dividers, using a maximum grade of 6 percent (so as to allow for a finished maximum of 7 percent). In many cases alternate lines were projected. Near the French Broad, Roanoke

SHORT STEEL STRUCTURES permit location of parkway against steep slopes. Shown here is one of three such structures, viaduct over deep ravine near Linville River. Early stage of construction shows steel girders resting on masonry piers and intermediate steel frame support.

STEEL VIADUCT IN Meadows of Dan (left) with four 108.5-ft plate girder spans and overall length of 548 ft, crosses Round Meadow Creek 100 ft above streambed. Similar structure (right), over Laurel Fork Creek, N.C., has four 110-ft spans and overall length of 546 ft. Viaduct is on 2-deg 30-min curve, 70 ft above streambed.

GUTTERS USED in earlier work on soils likely to erode on grades over 5 percent, are constructed of rock with mortared joints. Bituminous and sod gutters are also used.



STONE MASONRY RETAINING WALLS and guard walls from local quarries make fullest possible use of local labor and materials. Course aggregate for concrete is also from local quarries.

and James River crossings, these alternates were each about 40 miles long.

The maps then served as a guide to an experienced engineer in making a detailed field reconnaissance with an Abney level. The reconnaissance engineer investigated the alternate possibilities and reported on the best line between controls. Each reconnaissance line was marked in the field by red flags on trees and fences. After the best line had been selected, a transit line was run and a topographic strip map covering about 400 ft was made. Where the reconnaissance did not establish a clear choice, topography was taken and mapped on more than one line.

A tentative line was projected on these strip maps. The fact that all curves were spiraled—some consisting entirely of two spirals—made it easier to fit the line into the terrain. Use of retaining walls, tunnels and viaducts also helped in fitting the line to terrain, reducing length, and sometimes costs, and also reducing landscape scar. To avoid scars and because the fill would not "catch" on the steep slopes, excavated material often had to be hauled from full side-hill cuts to hollows where flatter slopes permitted dumping. This usually helped the alignment. After the paper location was made it was checked in the field, run in, profile and cross-section data were taken, and the finished plans were drawn.

The few roads that cross the mountains always pass through the gaps which generally have abrupt sides. Because of the terrain, a crossing at grade where the parkway crosses the gaps, would be not only dangerous but difficult. By passing over these roads not only is a grade crossing avoided but it is often possible to keep the parkway in better alignment and at a higher elevation. Consequently this practice is followed for practically all the intersecting paved roads.

Local Materials Are Used

The initial appropriation for the parkway, $6,000,000 from Public Works funds in August 1934, was made primarily to furnish employment. Plans and specifications therefore provided the fullest possible use of local materials. Stone masonry retaining walls and guard walls were used. The base course was of crushed stone from local quarries or crushed rock from the excavations. Most of the bridges have stone masonry abutments, wings and parapets. Stone masonry headwalls were used on all culverts, and stone curbs were used in the parking and overlook areas. Coarse aggregate for the concrete was produced in the local quarries.

Quarry sites were carefully selected in secluded spots not visible from great distances so as to be out of sight of the parkway traffic. The use of local materials provided employment for residents of nearby areas and resulted in low-cost construction. The resulting masonry structures were cheaper than the concrete, were of most attractive appearance, and seemed to fit the country.

Forty-two contracts have been completed to date for 316 miles of grading and base. One contract has been graded and is ready for base course. Contracts for two partially completed grading jobs were terminated because of the war.

Forty-three bridges have been completed by contract and five by Public Roads forces, including the largest masonry bridge over Linville River, shown in an accompanying photograph, and the large overpass in Bruck Creek Gap. Public Roads forces also did landscape planting on

50 miles, built several parking areas and stone guard walls. Seven contracts for 142 miles of bituminous top courses and other bituminous work have been completed. Work completed prior to the wartime shutdown cost $22,221,605 including engineering and surveys. Of this, contract work cost $19,371,778 and that done by Public Roads forces, $1,652,378.

Since the war, during 1946, one contract for 4.1 miles of grading and base course and three contracts for 72.7 miles of 2-in. bituminous plant-mix top course have been let, and are now under construction.

Eleven Tunnels Constructed

Of the eleven tunnels built, having a total length of 4,357 ft, the longest is 740 ft and the shortest 176 ft. Eight of the tunnels are in solid rock without lining. The others were lined wholly or in part. In one tunnel 115 ft of corrugated metal lining was used as a shield and a concrete lining was constructed against it. In another, 104 ft of timber lining was used as a shield inside which the concrete lining was built. About 300 ft of tunnel was lined with timber only. Where the overhead rock was not too unstable, timber lining was adequate. Double lining was used where the roof material was unstable.

After holing-in about 20 ft at one point where a tunnel of low cover was planned, it was converted into open cut because of unstable roof. One short tunnel partly completed with timber lining collapsed before the reinforced concrete was placed, and had to be converted to open cut. In the past, tunnel work has been planned after inspection of the ground to determine the probable character of tunnel material and lining. Present practice is to let a core-drilling contract and plan the tunnel and its lining from the data obtained. In some cases these data may reveal such unfavorable conditions as to require a change in line or grade to eliminate the tunnel. Analysis is now being made of core-drill data from ten possible tunnel sites.

Costs of tunnel excavation ranged from 2 to 5 dollars per cu yd, the latter being a 1941 price. Since each linear foot of tunnel requires 24 cu yd of excavation, the cost is from 48 to 120 dollars per ft of roadway for unlined tunnels. The average cost per foot for unlined tunnels has been about 80 dollars.

The largest masonry structure built to date, a three-span concrete arch over Linville River, is shown in an accompanying photograph. Ten stone-faced rigid-frame or arch-type

LARGEST MASONRY STRUCTURE built to date is 497-ft three-span concrete arch over Linville River. Roadway, 54 ft above bed of stream, is 26 ft wide with 5-ft sidewalks. Bridge, built in year by Public Roads forces at cost of $228,642, makes use of local quarries as source for masonry stone and coarse aggregate for concrete.

ACCESS IS PROVIDED to state road over which parkway passes at Buck Creek Gap. Steep-sloped gaps through which highways cross mountains make grade separations possible and keep parkway on better alignment at higher elevation. Present specifications require 8-in. base constructed in three layers. Each layer is bladed, rolled and, if necessary, watered. Two photographs, above, are views of same bridge.

SLAB-TYPE STRUCTURES with masonry abutments and wooden railings give rustic appearance in keeping with natural setting of parkway. About 20 such structures over 20 ft in length have been built.

bridges have been built to carry the parkway across state roads. The largest of these, over North Carolina Route 80 in Buck Creek Gap, is also shown in an accompanying photograph. Another bridge of this type was built in Rockfish Gap over U.S. 250 in Virginia. Eleven structures having spans of 14 to 25 ft have been built over local light-traffic roads.

The number of stream crossings is not great because the location is generally close to the divide of the Blue Ridge. However, on two sections, each about 10 miles long and near the North Carolina–Virginia line, the parkway leaves the divide or main ridge to shorten the distance. Similarly for about 10 miles south of Grandfather Mountain, the parkway leaves the main slope of the Blue Ridge and traverses the east side of the Linville River, which at this point runs along the eastern slope of the Blue Ridge. This diversion was made to get into easier terrain, to reduce the travel distance, and to permit the development of the Linville River valley for recreational use.

Both Masonry and Steel Structures Used

Six stone-faced concrete arches ranging in span from 25 to 60 ft have been built. About 20 slab-type structures longer than 20 ft have been built (see photograph). Six steel structures across deep ravines have been built and the substructure of a seventh has been completed. Several more are being planned. Two of these structures consist of four plate-girder spans, each about 546 ft long. The others are of I-beams and have overall lengths of from 95 to 235 ft. The steel viaduct in the Meadows of Dan, and a similar structure across Laurel Fork are shown in accompanying photographs. Three short structures were used to permit location closely against steep slopes and near cliffs of great height. One of these is also shown in an accompanying photograph. The largest of these six structures cost $171,643, the smallest $26,700.

The Blue Ridge Mountains rise high in the air and stop the low-lying clouds so that there is often fog on the parkway. Because of this, rather than because traffic normally needs it, a painted center-line strip is used. The center strip—continuous where passing is dangerous and broken where it is not—helps driving in fog when lights are useless in delineating the sides of the road.

Instead of "Curve" and similar warning signs, the parkway has been marked throughout with the safe speeds. Every section of the roadway has been designed for a certain safe speed. Speed signs are used wherever the roadway is designed for a safe speed less than 45 mph. With these guides the road is unusually safe for the terrain through which it passes.

Limitations on funds prevented making the roadway any wider than the minimum that would satisfy reasonable safety requirements on its mountainous and rocky route. The road was designed for the use of passenger cars and occasional buses only. Trucks were not provided for. Consequently the design adopted was a 20-ft pavement on a 30-ft grade with widening of both pavement and grade up to 4 ft on curves of less than a 500-ft radius. The 30-ft roadway width was carried through all tunnels and across all bridges, except for three long viaducts that have 24-ft widths between curbs. The maximum grade was fixed at 7 percent with liberal compensation for curvature on curves of less than 10 deg. All curves above 3 deg were spiraled and all curves of 1 deg or more were superelevated.

Construction and maintenance experience of ten years have developed improvements in specifications and construction methods. The first projects, approximately 100 miles in length, were built with 6-in. traffic-bound base courses, constructed in two layers. After the first season's observation, this was increased to three layers having a total thickness of 8 in. The early specifications for crusher-run stone base provided that all material should pass a 1-in. square sieve, from 40 to 60 percent a $\frac{1}{2}$-in.

(*Continued on page 80*)

AIRPLANE ENTERS CONSTRUCTION FIELD—Contractor on West Coast uses plane to travel from Los Angeles to job at Overton, Nev., where his company is constructing a sand refining plant. Four-place Navion plane cuts time required for inspection trip by car from two days to less than one.

Prefabricated Concrete Structures Test New Design Concepts and Construction Techniques

ARSHAM AMIRIKIAN, M. ASCE
Bureau of Yards and Docks, Navy Department, Washington, D.C.

TWO CONCRETE STOREHOUSES completed at the Naval Supply Depot, Mechanicsburg, Pa., differ from the conventional type of storehouse not only in appearance and concept of design and framing, but in construction technique as well. The storehouses were built as an experiment to explore the possibilities and relative merits of precast concrete as compared with other methods of construction. Corbetta Construction Co. of New York, N.Y., performed the work by lump-sum contract let on the basis of competitive bids involving other types of materials and methods.

TO A CASUAL OBSERVER the framing for the Navy's two precast concrete storehouses at Mechanicsburg, Pa., has the appearance of a monolithically poured-in-place concrete job. But close observation reveals a fine surface texture, rather unusual in ordinary concrete work, and faint lines of demarkation or jointing. For the bents, in reality, are formed by putting together a number of precast elements. A cross-sectional cut would reveal that these elements are actually hollow shells.

The bents support the roof framing and also provide partial support for the walls under wind loading. Their design is predicated on rigidity of jointing and on flexural strength. The hollow box sections are ideally suited for the latter purpose, since the required depth is obtained without sacrifice in weight—as contrasted to a solid section of comparable strength. Tapering lines of the component members are characteristic of the bents. These lines follow the stress pattern, providing a variable depth and thus resulting in additional reductions in weight.

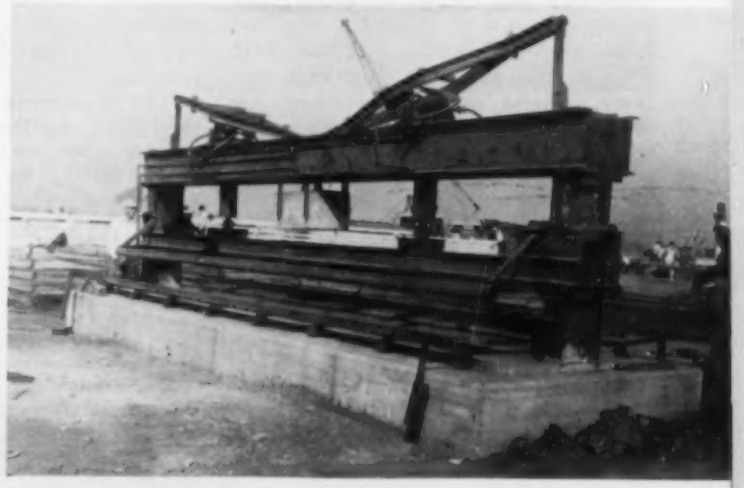
Each bent is composed of ten component framing members. Each member, in turn, is composed of two channel-shaped elements, bolted together to form a hollow box section. The webs of these channels are relatively thin, varying in thickness from $1^1/_2$ to $2^1/_2$ in. For handling purposes, the webs are stiffened with a series of diaphragms. The flanges are somewhat thicker, in order to contain the reinforcing bars of the element and to provide the necessary area for flexure.

For bolting pairs of channels together to form hollow box sections, a series of pipe inserts are cast near the flanges serving as sleeves for the connecting bolts. In addition, the channels are provided with special details at each end for facilitating the interconnection of members during the assembly of bents.

In general, the lines of splice are located at zones of minimum stress. The arrangement, however, is also affected by such practical factors as limiting overall dimensions and shape

BUILT OF CONCRETE, "reverse" molds (below) are tailored to close dimensional tolerances and polished to smooth contour. Utilizing 100 such molds, 4,000 pieces or elements are precast for framing of two buildings.

STEEL REINFORCING for each element is preassembled in form of cage or trough. Specially designed machine (right, top) bends wire-mesh mats. Jigs and benches (right, bottom) are used for assembly and welding.



CASTING OPERATIONS are performed at site. Unavailability of lumber for protective shed necessitates work being done in open under winter weather conditions. Concrete brought to casting site in 3-cu-yd truck mixer is poured into molds, spaded and vibrated in place and struck to finish.

SPECIAL LIFTING PAD utilizing vacuum or suction device removes casting from mold. To permit quick turn out of castings, high-early-strength cement is used to obtain minimum strength required at time of removal. Elements are removed as early as 20 hours after pouring.

and weight of the resulting members in accordance with available facilities for handling and erecting. The writer's concept of subdividing the box sections into two channels is also based on practical considerations of casting. It is readily seen that, unless a simple expedient is devised for casting the hollow section, a great part of the benefits derived from the use of such elements is lost in the complicated process of their fabrication. In this respect the channel section provides a most satisfactory solution. For its use not only simplifies the required form work or molds, but makes it possible to cast very thin web sections. These sections are cast by placing the web form in a horizontal position and pouring the concrete in the flat, thus assuring control of quality as well as providing ease of casting.

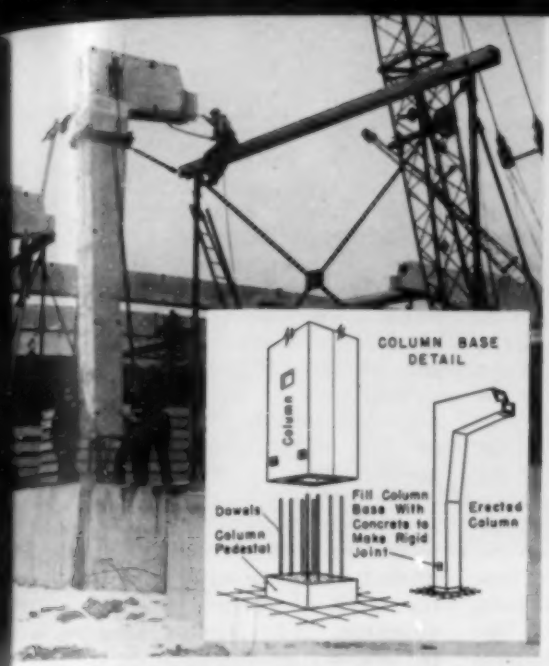
Precast Roof Panels

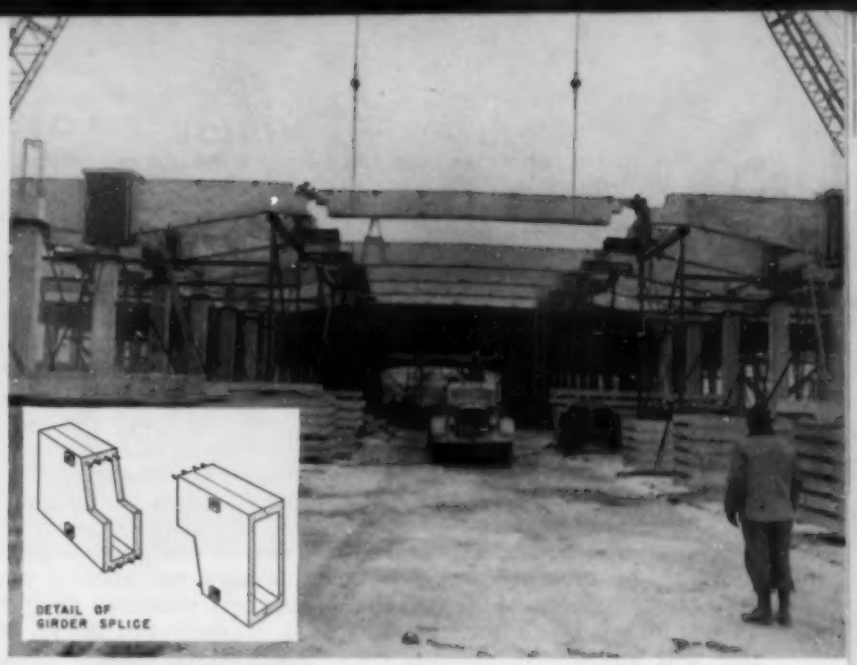
The roof slab and its supporting subframing are cast together to form a ribbed panel 5 ft wide and 20 ft long. The slab is only $1^1/_4$ in. thick and is reinforced with welded wire fabric of 2-in. mesh. The ribs consist of two edge beams of 8-in. depth along the long edges and 6-in. cross-beams, spaced 5 ft on centers, dividing the panel into square sub-panels.

The statement is often made that the basic method of building construction has changed but little during centuries of human progress. The work involved in precast concrete building construction is still performed mainly by "on-the-job" masonry and carpentry. That the success of such an undertaking is dependent on many indeterminate factors or elements—both human and natural—is equally as true for conventionally poured-in-place concrete construction. In contrast with older methods, the precast concrete technique presents a new concept of construction. This new method simulates factory production in the planning and the execution of the work. By this approach the labor waste is minimized, the work progress is

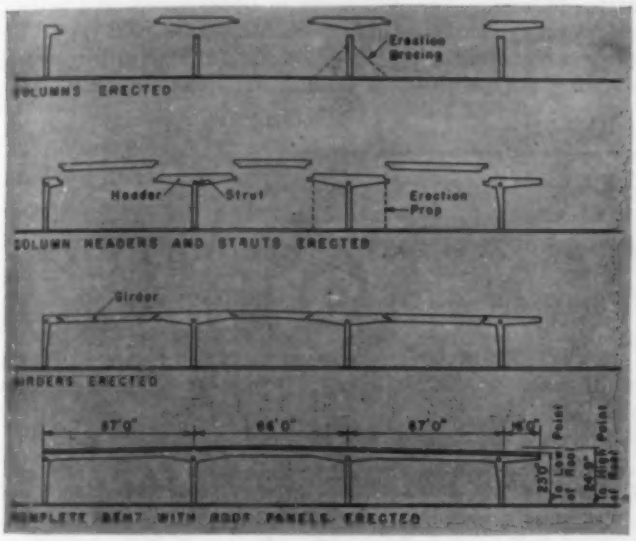
CAST ELEMENTS are placed in stacks near edge of casting platform for curing and temporary storage. Channel-shaped elements of bents are subassembled in pairs for transportation to building site.

CASTINGS ARE LOADED on trailer by means of slings attached to crawler crane. At building site castings are placed at prearranged locations on floor, convenient for erection.





ERECTION PROCEDURE is similar to that of steel structure. L-head is lowered over splice dowels projecting from floor (left). Connections are made by grouting joint pockets into which splice bars are projected. Members, hoisted and positioned by two boom derricks (right) are held securely in position, prior to jointing, by means of braces and props. Adjoining reinforcing bars are spliced by welding.



SEQUENCE OF ASSEMBLY is as follows: (a) Columns; (b) headers; (c) struts; (d) girders; and (e) roof panels. Jointing of columns to floor stubs, columns to headers and struts and girders to headers, follow erection of members in that order.

ROOF-LEVEL CANOPY, over loading platform on one side, adds 16-ft width to 600×200-ft dimensions of each building. Single-story frame rises 24 ft above first-floor level providing minimum vertical clearance of 19 ft for storage.

COMPLETED FRAME (left) resembles arcade of vast magnitude formed by long series of four-legged bents with surmounting paneled ceiling roof slabs (right). Tall, slender, gracefully haunched bents span transversely and subdivide building into three bays of about 67 ft each. In longitudinal direction bents are spaced 20 ft on centers and are interconnected by four lines of struts located along tops of columns.

expedited, and economy in cost and control of quality is assured.

Some Problems in Precasting

A thorough study was made of each problem in design, details, fabrication and erection in planning the two Navy storehouses. The project being the first one of this type of construction, the solutions of most of the involved problems had to be worked out from scratch—without the benefit of precedents. The final solutions were obtained, in most cases, after giving due consideration to various alternatives, and in some instances, by experimentation.

Problems in design of the thin-shell framing included such items as allowable unit stresses, reinforcing, concrete aggregate, jointing and all related matters, necessitating the development of new design standards and specifications. The design of the thin sections was predicated on the use of high-strength concrete obtained from a mix containing 8 to 9 bags of cement per cubic yard of concrete and high-yield reinforcing in the form of welded wire fabric of close mesh. The coarse aggregate consisted of pea gravel and crushed-stone screenings. Accompanying illustrations show details of casting the elements and their erection to form the framing of the two buildings.

The progress of erection was from one end of the building towards the other, and from the sides towards the center, with a crane in each of the two side bays covering the lifts of the assembly in a symmetrical sequence. The weight of the heaviest lift, composed of the girder segments in the side bays, was about 7 tons. These members measured 43 ft 6 in. long, 36 in. deep and 20 in. wide. The 5×20-ft roof panels weighed about 1.5 tons each.

In general, the framing arrangement and the basic details, as conceived in the original design, were carried out with little change. As was to be expected, during early stages of the construction, certain kinks developed retarding the progress of the work. The elimination of these kinks necessitated some deviation from the originally planned procedure.

As the construction progressed not only were these kinks eliminated but valuable experience was gained to smooth each operation. This improvement in technique, and the resulting gain in speed, was clearly demonstrated by the fact that the erection of the second building was accomplished in only 18 days—as compared with 40 days required for the first building.

The successful completion of the project conclusively demonstrates the merit of precast concrete construction. The success attained is particularly gratifying since the two buildings were constructed under unfavorable conditions of weather using rather crude equipment. As a planned method, with assured advantages in cost, speed and quality, this new technique will no doubt play an important role in the postwar era of building construction.

Experimental Unit Tests Universal Military Training Plan

TECHNICAL ENGINEERING as well as physical fitness is taught to 18-year-old volunteers in the Army's Universal Military Training Experimental Unit at Fort Knox, Ky. Treated as students rather than draftees, these UMT trainees are testing the program called for in the universal military training bill now before Congress.

The model unit at Fort Knox is designed to accumulate data on the merits and deficiencies of the present plan and to demonstrate its operation for the public and Congress. Besides receiving basic military training, the approximately 650 enlisted men in this unit, selected from 18-year-old regular army volunteers, study surveying, bridge-building and other military construction. This type of training would make up the first half of the year's program under the UMT plan actively endorsed by the ASCE.

PRACTICAL MILITARY ENGINEERING is part of UMT training program at Fort Knox, Ky. Trainees learn to construct fixed and floating bridges, roads and other military structures, and receive training in demolition and engineering reconnaissance. In photograph (below, left) UMT trainees are instructed in removal of trees. In this operation—which requires about 10 minutes, including instruction—cable is adjusted to proper height for felling tree by tractor. Tree is rolled to remove branches and free roots of dirt. Engineer platoon (below, right) studies assembly of Bailey bridge, type of structure developed by British and widely used by Allied armies in World War II.

RESEARCH AT LADD FIELD near Fairbanks, Alaska, where permafrost table is only 3 or 4 ft below surface is conducted on three subareas. Area No. 1, pictured here, is used principally to determine effect of climatic factors. Part of area (background) is left in its natural state, next area has had brush and trees cleared but has not been stripped, third area has been stripped to depth of 12 in. Temperature measuring instruments are installed in each section.

Studies Determine

Proper Construction Procedures in Permafrost Areas

SINKING RUNWAYS on airfields and sagging buildings on many Alaskan installations became a wartime headache for Army engineers who sought to meet critical construction deadlines during the war. Sliding, cracking and shrinking topsoil necessitated the rerouting of nearly 500 miles of the Alaskan Highway in 1943. These and other problems, caused by what has been dubbed "permafrost," prompted the research project that is being continued by the St. Paul District, Corps of Engineers, with the cooperation of two universities, Minnesota and Purdue. Permafrost is not new, but the establishment of military bases in Alaska and other frigid zones has indicated the need for further study and investigation.

During the war, districts closer to Alaska had all they could do to keep pace with the accelerated construction program, so the St. Paul District, of which Col. Walter K. Wilson, Jr., is district engineer, was designated by the Chief of Engineers to conduct the permafrost investigations. A district office was chosen for the task because it is a permanent organization and functions in peacetime as well as war, thus assuring the continuation of the program. Henry J. Manger, head of the permafrost division of the St. Paul District office, is director of procedures on the three research "sets" located in Alaska, at the University of Minnesota and at Purdue University.

A field soils laboratory is set up at Fairbanks, Alaska. Research to determine thermal properties of soils and insulating materials is being conducted at the University of Minnesota. Present tests will determine thermal conductivity of soils at various densities, moisture contents and temperatures. Purdue University is handling the air-photo reconnaissance phase of the work. The permafrost investigation is now well under way, with 20 employees in the field office at Fairbanks and vicinity and ten employees in St. Paul.

The Army is seeking the best methods for constructing airports and airport structures, buildings of all types, and utilities in permafrost areas. It wishes to determine whether surface vegetation should be removed or left undisturbed, the best type of insulating material to assure a stable foundation, the depth piling should be placed in permafrost to prevent fail-

UNWAY DESIGNS are studied on Area No. 2 at Ladd Field, where 26 runway sections ave been constructed to test various insulating materials. In left foreground are moss and pruce boughs, in back section is Foamglas in place. Additional blocks of Foamglas are tacked at extreme right.

ure of structures and the value of air photo studies in selecting construction sites.

Permafrost Table and Active Layer

The upper limit of permafrost is referred to as the permafrost table. It is variable in depth from the surface but remains relatively constant at any point unless the natural surface is disturbed. The area above the permafrost table is known as the active layer. If it is composed of coarse-grained, well-drained material, no heaving takes place during seasonal freeze and thaw. However, if it is composed of fine-grained material, the effect of heaving and settling can be disastrous.

Natural vegetation in Alaska, particularly moss, acts as a good insulating material and when the natural surface is removed prior to construction, the heat transferred into the ground lowers the permafrost table, and the Alaskan soil, if fine grained and silt, turns into a jelly-like mass. There are many variations of ground movements—creeping, sliding, shrinking, cracking, heaving and settling—all of which may occur in hundreds of combinations and gradations.

Fine-Grained Soils Cause Difficulties

It was these difficulties of heaving, frost boils, and mud, common to the spring breakup in the United States, that the Army engineers experienced when they started airfield construction on fine-grained soils in permafrost regions.

Added to that was the complication of underlying permafrost preventing any subterranean drainage of excess water. The fine-grained soil in the permafrost regions retains water like a sponge and is so fluid that it flows and fills ditches excavated through it to carry off the water. After the best possible drainage the subgrade still could not support heavy equipment in many areas where the vegetative cover had been removed.

Within one year after construction of runways at Northway airfield in Alaska, failures occurred where the subsoil was fine-grained material. Large sections of the runway had to be completely dug out and the excavated area backfilled with coarse-

A paper by H. J. Manger on permafrost investigations in Alaska is scheduled for presentation before the Highway Division at the ASCE Summer Convention. A brief summary of the paper will appear in the August issue of CIVIL ENGINEERING.

TYPES OF FOUNDATIONS under identical buildings and heating conditions are studied in Area No. 3 at Ladd Field. Under five of eight buildings under test base course is gravel. One building is placed on mud sills on natural surface. Other two are on posts extending $2^1/_2$ ft above ground to permit circulation. Houses are heated to temperature of 60 deg F.

RUNWAY SECTIONS under construction at Ladd Field test gravel fills of 8-, 10- and 12-ft depths with 5-in. asphalt surfacing.

PERMANENTLY FROZEN GROUND, which covers one-fifth of earth's land surface, varies in thickness from zero at the southern border of Alaska to 3,000 ft in Siberia. Greatest thickness determined to date in Alaska is 960 ft at point south of Point Barrow. Pictured here is subgrade in permafrost area, after stripping and thawing.

grained material. Providing adequate foundations under large heated buildings was an even more difficult problem than runways, since the heat transferred into the ground continues to thaw the permafrost for many years. A building over the pump house at Northway began to settle and other buildings were warping out of shape, all because of permafrost.

Roads proved a headache, too, by becoming one continuous boil and impassable to motor-drawn vehicles. Valuable time was lost repairing roads in order to proceed on construction projects. Repeated failures and excessive maintenance costs prompted the Air Transport Command to investigate the causes. Their investigation was followed in 1944 by that of the Engineer Board, which sent a crew of experts to the airfields in Alaska to make a study of foundation conditions and construction failures.

Probings were taken at the same locations as those made in 1942 by the Air Transport Command. The results indicated a marked lowering of the permafrost table in the two-year period, and that a number of buildings were warped to a greater extent than in 1942. These findings prompted the Engineer Board to recommend a continuation of the studies over a long period of time.

Research work has already proved valuable in selecting the most suitable sites. Alaska is a big place. Picking out suitable ground from the air is one thing and walking over it to find satisfactory top soil on which to build is another. It has been discovered that during preliminary aerial reconnaissance for possible construction sites, many easily recognized terrain features offer valuable clues to the presence or absence of permafrost.

Ridge lines, drainage patterns, flood plains, ground slope and dozens of other topographical characteristics serve as dependable guides to likely construction sites. Tree species also offer clues to soil types and conditions. For instance, birch usually indicates unfrozen ground; spruce, wet ground and a high permafrost table; willow, presence of underground water; pine and fir, well-drained granular soil, low permafrost, or no frozen soil at all.

Piling Tests Conducted

Tests being conducted at Ladd Field, near Fairbanks, Alaska, include an investigation of the effectiveness of piling in frozen ground. Three piles have been placed with penetration into the permafrost varying from zero to three times the thickness of the active zone. These tests will determine the effect of adfreezing and the depth piling must be placed to resist the forces of frost action in the active layer.

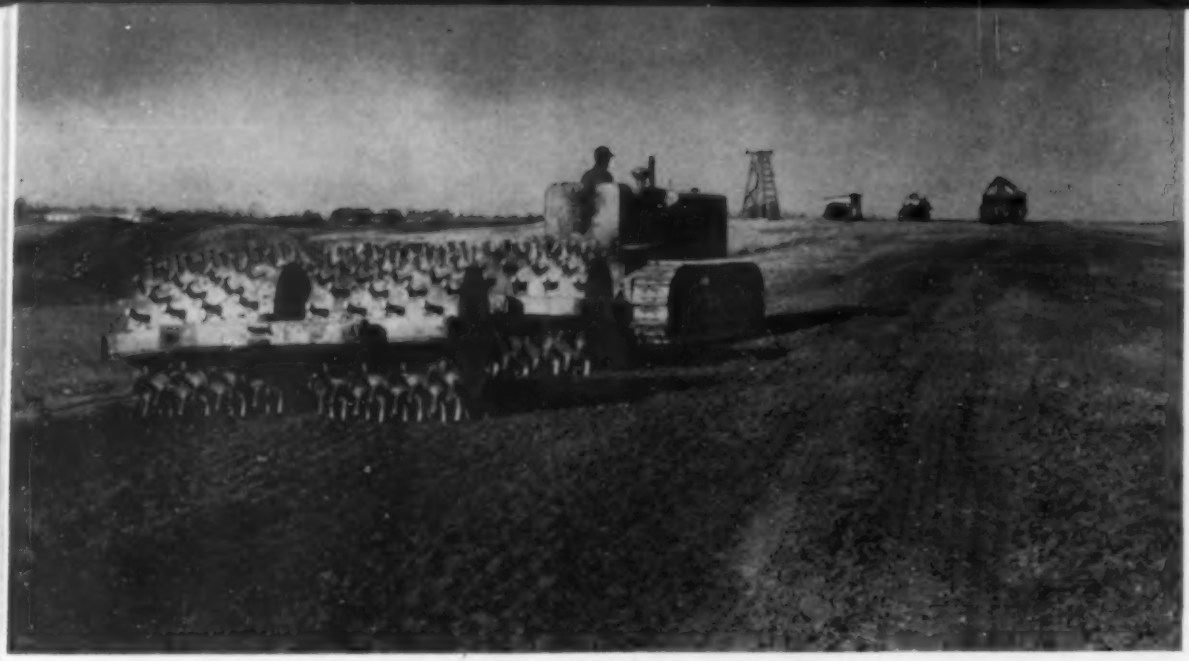
The effect of color on heat transfer into the ground is also being recorded by tests on concrete slabs. One is painted white, one black and the third is of natural concrete. Other tests being conducted at Ladd Field are shown in accompanying photographs.

As the various reports and readings from the University and field sources in Alaska are transmitted to the office in St. Paul, the data are correlated and the results are evaluated to produce construction guides that will aid in future design in permafrost areas. Although the cost of the investigation runs into thousands of dollars, it is believed that the entire cost may possibly be saved on one large construction project by proper site selection and foundation design.

Results should go far in promoting the growth and settlement of Alaska, which has been hampered in the past by inadequate transportation, building failures, property damage, waste of time, money and materials caused by permafrost.

Enders Dam Is 1,500,000-Cu-Yd Earthfill Structure

NOW UNDER CONSTRUCTION by Bureau of Reclamation at cost of $4,109,924, Enders dam and dike on Frenchman Creek, about 45 miles northwest of McCook in southwestern Nebraska, will require approximately 1,500,000 cu yd of earth fill. Embankment will be about 2,600 ft long and approximately 110 ft high. Two-mile-long dike will extend from valley of Frenchman Creek almost to town of Enders. Six radial or drum-type gates, each 50 ft long and 30 ft high, will control concrete spillway at south end of dam. Part of Frenchman-Cambridge unit of Missouri Basin project, Enders dam and dike will provide for irrigation, flood control, silt retention and recreational opportunities. Wunderlich Contracting Co., of Jefferson City, Mo., are contractors on the project.



SHEEPSFOOT TAMPING ROLLERS, drawn by Caterpillar D7 tractor, are employed to obtain maximum density in fill section at De Kalb County Airport, Chamblee, Ga. Usual specifications require that the section be built up in uniform layers of from 6 to 8 in. Water is added until specified optimum is obtained in each layer before compacting to specified density.

Soil Compaction Experiments Point Way Toward Stronger, More Economical Subgrades

Tests Aid Construction of Adequate Subgrades for Heavier Wheel Loads on Modern Highways and Airfields

WARREN D. CURTIS
Member, Student Chapter ASCE, University of Utah

THIS ARTICLE is based on the prize-winning paper titled "Soil Compaction," presented by the author in competition with other Student Chapter members at the Society's Spring Meeting Student Conference in Phoenix, Ariz.

RESULTS OF experimental work conducted at the University of Utah, in which the variables in soil compaction of moisture content, bearing power, density, and compactive effort were carried through their respective extremes, for different type soils, indicate that existing methods of compaction control do not exhaust the density-bearing power possibilities for a given soil.

THROUGHOUT THE NATION today, an extensive highway and airport development program is gaining momentum. The engineer, in contemplating this new construction, must not only design for increased traffic volume, but must also consider greater loads. Most highways have been designed for a 9,000-lb wheel load, and a value of 40,000 lb is common for present-day terminal airports. An indication of the trend in aircraft design is the fact that the new Army bomber, the B36, when fully loaded, weighs 340,000 lb. Limited only by the highway regulations of the various states, wheel loadings of trucks are also increasing. The subgrade, being the main supporting member of the highway or the airport, must of necessity be designed with sufficient strength to withstand these greater loads.

Another essential factor to consider in constructing an adequate subgrade for increased wheel loads is that of providing stability, particularly in sections where extensive fill is used. Records show that maintenance costs for fill sections for most highways have been excessively high. Failures of such sections have followed a uniform pattern; settling and shifting occurs in the subgrade, the flexible surfacing material (bituminous products are predominantly used) conforms to the movement and a rough, washboard condition develops. The subsequent replacement of a part of the wearing surface becomes a seasonal problem.

In the current accepted method for providing strength and stability in a subgrade, the fill section is built up and compacted in uniform layers of from 6 to 8 in. Water is added to the soil to obtain a specified optimum moisture before compacting to a specified density with heavy sheepsfoot (tamping) or wobble-wheel (rubber-tired) rollers.

SOIL SAMPLE IS COMPACTED into standard AASHO T-99-38 cylinder. Standard blow consists of driving mechanism picking up 5½-lb weight, enclosed in vertical tube, lifting it to height of 1 ft and dropping it to soil surface. Soil is placed in cylinder in three uniform layers. Tests show density and bearing-power relationships when compactive effort for successive samples is ranged from 25 to 700 blows per layer and moisture content is varied from dust to mud extremes.

The value of compaction is generally accepted, but acclaim for compaction control methods is not unanimous. Opinion varies somewhat as to the exact test to be employed, and discrepancies from desired results are attributed to the inherent, unpredictable nature of the soil itself. Common to all control methods, however, is the process of conducting laboratory tests on representative samples of the soil to be compacted—critical data thus obtained forming the basis for field specifications. The difference in control methods lies in the data that are considered critical.

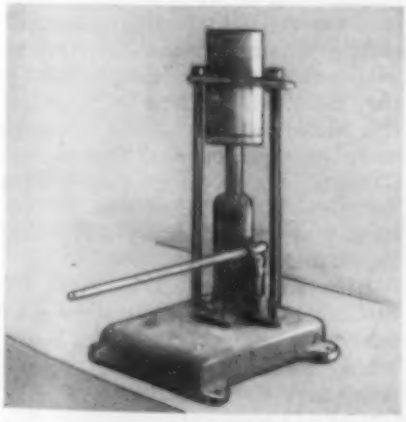
Compaction and Density Test T-99-38 of the American Association of State Highway Officials specifies that a soil sample, representative of that to be used in a fill section, be placed in a standard mold (volume $^1/_{30}$ cu ft) in three successive uniform layers. Each layer is to be compacted by 25 blows from a $5^1/_2$-lb hammer, one blow consisting of dropping the hammer from a height of 1 ft. Compaction completed, the soil is struck off level with the top of the cylindrical mold. Knowing the dimensions of the mold and the tare weight, both the volume and the weight of the soil can be determined and subsequently the wet density calculated:

$$\text{Wet density} = \frac{\text{wet weight}}{\text{volume}}$$

A sample taken from the compacted soil is dried in an oven, the moisture in percent of dry weight determined, and dry density calculated:

$$\text{Dry density} = \frac{(\text{wet density})\ (100)}{(100 + \text{moisture percent dry weight})}$$

The process is repeated at successively increasing moisture contents until data defining a condition of maximum density are obtained. The moisture content at which this density occurs is termed optimum moisture, and the corresponding density is considered to be the maximum for the soil at that particular compactive effort.

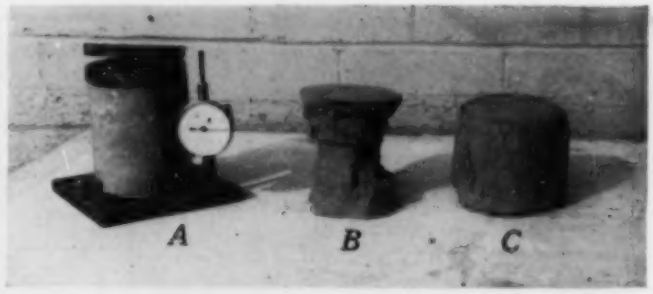


COMPACTION COMPLETED, and density determinations accomplished, soil sample is extruded from the mold by means of the hydraulic press.

The California bearing ratio test includes other factors not specifically pertaining to compaction itself. However, it has compaction specifications that require a moisture content approximately 2 percent less than the AASHO optimum, and a compactive effort corresponding to 2,000 psi in applied load on a compression machine. The resulting density is greater than that obtained by following the AASHO specifications. Field compaction at this reduced optimum moisture is continued until a specified percentage of the greater density is reached.

Henry C. Porter of the Texas Highway Department has accomplished extensive research along the lines of strength investigations of unconfined soils. Using cylindrical samples that had been extruded from the AASHO mold, compression tests were made and sufficient data were recorded to define the stress-strain characteristics of the soil. Laboratory results were correlated with a field loading device and compaction was accomplished accordingly. In this particular series of tests, Porter emphasizes bearing power in preference to density as compaction criteria.

Three control methods have been mentioned. Others which include modifications and combinations of those described are employed. It is evident that compaction control has several widely varying concepts, each of which has its basis in fact, yet each prescribes different critical conditions to be met in the field process. Not to be overlooked is the fact that subgrades for heavily traveled roadways sometimes have greater densities and higher strengths than would initially result from compliance with any of the prescribed tests.



AFTER EXTRUSION from mold, soil samples are prepared for compression tests (A). Note base plate, top leveling head, and extensometer for measuring vertical deformation. Each cylinder is placed in compression machine and vertical load is applied at uniform rate until failure occurs. Within certain moisture range, soils exhibit elastic characteristics, hourglass shape, and angular failure patterns as shown in Sample B. With increase in moisture, plastic characteristics are indicated by pronounced deformation with applied load, as shown in Sample C.

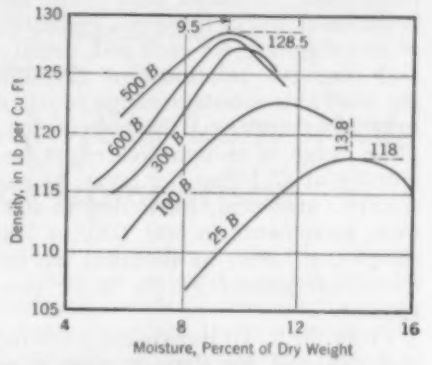


FIG. 1. DRY DENSITY in pounds per cubic foot is plotted against moisture in percent of dry weight. Letter B indicates blows per layer. Note that AASHO standard of 25 blows per layer gives density of 118 lb per cu ft at 13.8 percent moisture. This value is contrasted with 128.5 lb per cu ft at 9.5 percent moisture of 500-blow-per-layer series. Graph illustrates fact that density increases with increase in compactive effort, provided moisture control is maintained, and that ultimate density is defined by optimum compactive effort, as well as optimum moisture content.

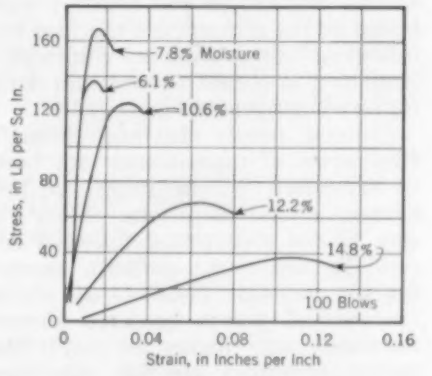


FIG. 2. STRESS-STRAIN relationships through variable moisture range for common compactive effort of 100 blows per layer show that up to a certain percent moisture, soil (A4 type in this case) exhibits elastic characteristics as shown by straight-line stress-strain relationships. Increase in moisture content results in indication of plastic characteristics as is shown by increase in strain compared to stress. Curves for other compactive effort followed same pattern except for values of ultimate stress.

Based on the apparent variations in compaction control concepts, and with the objective of obtaining correlating information and investigating the possibilities of greater strength from the soil, comprehensive tests were conducted at the Engineering Experiment Station, University of Utah, during the summer of 1946.

Four soil samples investigated contained clay ranging from 15 to 75 percent and fell within the Public Roads Administration classification of A2 to A6. Also conducted for correlation purposes were the AASHO T-99-38 and the California bearing ratio tests. A major part of the experimental work, however, consisted of investigating, for each soil, density and strength relationships through the workable moisture range (dust to mud extremes) and through a complete range of compactive effort beginning at 25 blows per layer, as per AASHO standard, increasing in uniform increments to 500, 600, or 700 blows per layer, as dictated by information gained as the work progressed.

From 60 to 70 individual tests for strength and for density were conducted on successive samples of the same type soil, the moisture content and the compactive effort being progressively varied. Each sample was compacted into the AASHO cylinder, and density determinations were accomplished accordingly. Relative strength was measured in the manner suggested by the Texas research. Through the use of a small 3-ton hydraulic press (see accompanying illustration), the soil samples were extruded from the mold and the resulting unconfined soil cylinder was tested on the compression machine by following test procedures commonly employed to obtain stress-strain data for any homogeneous material.

General trends observed through this series of experiments can best be discussed by reference to the curves derived therefrom. Since all four of the soils tested followed essentially the same pattern, except for the moisture contents at which the critical points occurred (lower for sandy soil—higher for clay), the curves indicated are for only one sample, an A4 type, described as "silty soil with a minimum of coarse material."

Trends in Density

As the compactive effort increases, the corresponding maximum density also increases (see Fig. 1), and a decrease in optimum moisture is observed. Attention is called to the fact that a maximum density of 128.5 lb per cu ft is obtained when a compactive effort of 500 blows per layer is applied, and that this maximum density occurs at 9.5 percent moisture. These data are to be contrasted with the 118 lb per cu ft, 13.8 percent moisture, of the 25-blow-per-layer AASHO standard. Compactive effort of 600 blows brought a slight decrease in density, and the 700-blow-per-layer curve (not shown) was essentially the same as obtained for the 600 series. Thus, the optimum compactive effort can be tabulated at 500 blows per layer. (Optimum compactive effort ranged from 400 to 500 blows per layer in the four soil types tested.)

Results of these tests indicate that:

1. For every compactive effort applied, there is a corresponding maximum density and a corresponding optimum moisture.
2. For any given soil, there is an ultimate density that can be obtained, this density being dependent not only upon an optimum moisture content, but also upon an optimum compactive effort.

Load-deformation data for the successive soil samples, when tabulated and corrected for increase in cross-sectional area, gave stress-strain curves such as those shown in Fig. 2. Although the curves indicated are for 100 blows per layer, curves for other compactive efforts had essentially the same characteristics except for the magnitude of the ultimate strength. Up to about 9 percent moisture a pronounced straight-line relationship between stress and strain is observed, indicating essentially elastic characteristics of the soil within that moisture range. Also, as the moisture content is increased, the deformation (strain) becomes more pronounced and the ultimate strength is reduced accordingly. Samples indicating these two extremes are shown in an accompanying photograph.

Ultimate strength as obtained from the high points of the stress-strain curves for a given compactive effort, when plotted against moisture content, gave curves similar to those in Fig. 3. These curves indicate that increase in compactive effort results in a corresponding increase in ultimate strength, until at 500 blows per layer a maximum strength of 350 psi is

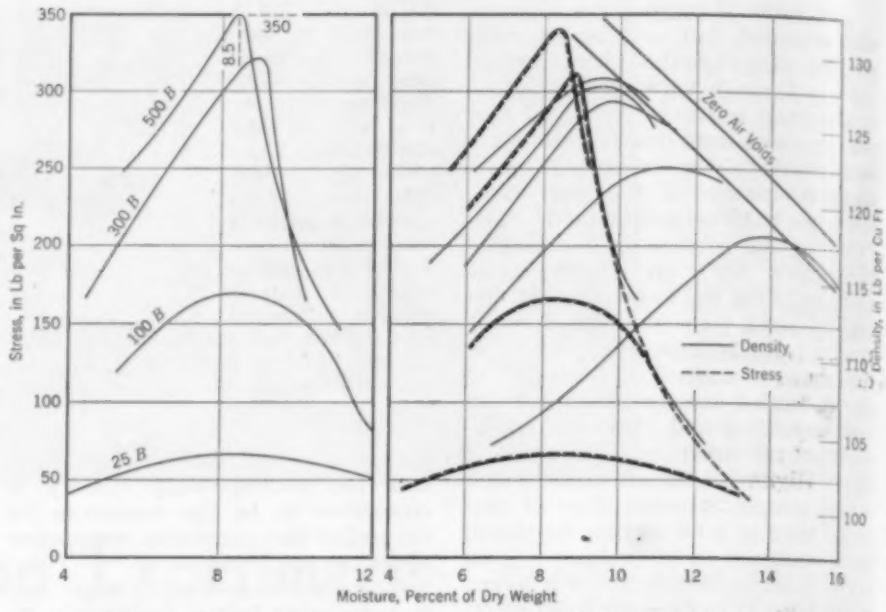


FIG. 3. ULTIMATE STRESS for various compactive efforts are plotted to uniform moisture scale. Values of stress are obtained from peak points of stress-strain curves (see Fig. 2). Curves show that ultimate stress increases with compactive effort and that with optimum amount of compaction and proper moisture control, ultimate strength for soil can be obtained. Since strength tests are conducted on unconfined sample, actual bearing power of soil confined within subgrade would be much greater.

FIG. 4. DENSITY (Fig. 1) and stress (Fig. 3) are combined to a common moisture scale. Zero air-voids curve represents theoretical maximum density that may occur if there are no air voids in soil mass. It is evident that wet side of density curves closely approach, but never reach, theoretical density, and that increment between two remains essentially the same. Curves show that ultimate density and ultimate strength occur at nearly same moisture content. Also indicated is fact that for given moisture content values of strength and density will be reached, and that these values cannot be exceeded regardless of further compaction.

reached. Although not plotted, ultimate strength for 600 blows and 700 blows per layer was slightly lower than is indicated for the 500 blows. It is evident that maximum strength occurs at essentially the same moisture content regardless of the compactive effort applied. Strength trends can be summarized as follows:

1. For every compactive effort, there is a maximum strength that can be obtained, at a corresponding optimum moisture.

2. Conditions of ultimate strength within a soil sample are reached, provided that an optimum compactive effort is applied, and provided that the soil is at the proper moisture for producing this ultimate strength.

The overall relationship between strength, density, moisture, and compactive effort can best be shown by combining the strength and density curves into a common moisture scale. In Fig. 4, heavy lines have been purposely drawn on the wet side of the strength curves and on the wet side of the density curves. It seems evident that for a given moisture content a maximum density is reached, beyond which increased density cannot be obtained regardless of further compactive effort applied. This observation is confirmed by calculation of sufficient points to define a dry density curve at zero air voids. This curve of dry density at zero air voids is the maximum theoretical density that could be obtained if there were no air voids within the soil mass. It is calculated by the following formula:

$$\text{Dry density} = \frac{(\text{wet density})\,(100)}{(100 + \text{moisture percent dry weight})}$$

$$\text{Wet density} = \left(\begin{matrix}\text{specific gravity of soil mass including soil particles and water}\end{matrix}\right)\left(\begin{matrix}\text{unit weight of water}\end{matrix}\right)$$

Unit weight of water = 62.4 lb per cu ft

$$\text{Specific gravity of soil mass (soil particles and water)} = \frac{(s)(1 + w)}{(1 + ws)}$$

in which,

s = specific gravity of the soil particles
w = moisture in percent of dry weight

Therefore: Dry density at zero air voids =

$$\frac{(s)(1 + w)(62.4)}{(1 + ws)(1 + w)} = \frac{(62.4)(s)}{(1 + ws)}$$

Dry density thus obtained, plotted against moisture content in percent of dry weight, defines the zero air voids curve. It can be noted that the actual density closely approaches, but never reaches, the theoretical density, and that, regardless of the compactive effort applied, the increment between the two remains essentially the same.

The wet side of the strength curve also follows a well defined line. It

(*Continued on page 80*)

CRITICAL DATA obtained in laboratory tests of soil samples are used as basis for field specifications in constructing highway and airfield subgrades. Here Le Tourneau Sheepsfoot roller compacts soil on 470,000-cu-yd highway project near Zanesville, Ohio.

New Construction Activities Converted to 1939 Prices for Comparison

YEARLY CONSTRUCTION volumes converted to 1939 prices for purposes of comparison are presented in the Department of Commerce report "Construction and Construction Materials," May 1947. To obtain the yearly totals given in Table I each class of construction is deflated by an appropriate construction cost index to give a direct comparable measure of physical volume. Since at best most cost indexes merely approximate changes in costs, the estimates in 1939 prices provide only crude indicators of physical change.

The composite indexes for total new construction, shown in the table are implicit indexes computed by dividing the totals in current prices by those in 1939 prices. Since the totals in 1939 prices were obtained by adding the estimates for the separately deflated classes of construction, the composite cost indexes are the equivalent of variably weighted indexes.

The cost indexes selected for the different classes of construction were chosen from the large number now compiled by private and governmental agencies. In those instances where more than one index was relevant, selection was a matter of judgment conditioned by such factors as representativeness of the labor, material and overhead components included, geographic coverage, etc.

Department of Commerce reports indicate that for the first four months of 1947 all new construction activity exceeded 3.1 billion dollars, 39 percent above the figure for the corresponding period for 1946. Private construction constituted more than three-fourths of the total and amounted to 2,480 million dollars, and 30 percent above the volume put-in-place during the first four months of 1946.

TABLE I. TOTAL NEW CONSTRUCTION ACTIVITY IN CURRENT AND 1939 PRICES, AND COMPOSITE COST INDEX, 1915–1946

(Dollar Figures in Millions)

Year	Total New Construction Activity		Composite Cost Index	Year	Total New Construction Activity		Composite Cost Index
	Current prices	1939 prices			Current prices	1939 prices	
1915	2,935	4,990	58.8	1931	5,980	6,384	93.7
1916	3,456	5,311	65.1	1932	3,260	4,022	81.1
1917	4,142	5,216	79.4	1933	2,223	2,593	85.7
1918	4,717	5,114	92.2	1934	2,756	2,951	93.4
1919	5,738	5,417	105.9	1935	3,110	3,449	90.2
1920	6,119	4,575	133.7	1936	4,714	5,096	92.5
1921	5,548	5,090	109.0	1937	5,308	5,276	100.6
1922	7,042	7,205	97.7	1938	5,018	5,047	99.4
1923	8,604	8,030	107.1	1939	6,062	6,062	100.0
1924	9,577	9,017	106.2	1940	6,807	6,637	102.6
1925	10,559	10,065	104.9	1941	10,308	9,190	112.2
1926	11,179	10,624	105.2	1942	13,353	10,362	128.9
1927	11,130	10,663	104.4	1943	7,734	5,689	135.9
1928	10,801	10,341	104.4	1944	4,073	3,032	134.3
1929	9,913	9,303	106.6	1945	4,595	3,291	139.6
1930	8,059	7,884	102.2	1946	10,007	6,200	161.4

EADS BRIDGE over Mississippi River at St. Louis, Mo., — monument to skill of early bridge designers — is carrying increased loads of modern highway and railroad traffic in its 74th year of service.

Steel and Concrete Deck

Replaces Timber Roadway on Eads Bridge

AFTER 73 YEARS of service, famous Eads Bridge over the Mississippi River at St. Louis is having the timber and steel-framed upper deck replaced by a lighter and stronger steel and concrete roadway. A high spot in the construction of Eads Bridge (1867–1874) was the attempted closure of the tubes at the crown of the arch through use of ice and river water. Failing by $^5/_8$ in. to effect a closure, the idea was abandoned in favor of adjustable tubes contrived by the bridge's famous designer, Capt. James B. Eads.

NEWEL J. LAW, JR.

Assistant Bridge Engineer, Terminal Railroad Association, St. Louis, Mo.

EXCEPT FOR RENEWED and strengthened highway and railway decks, the Eads Bridge over the Mississippi River at St. Louis stands essentially as constructed—a monument to the pioneering genius and engineering skill of its builders. Designed, and its construction supervised by Capt. James B. Eads, after whom it was named, the structure has been unique among the notable bridges of the world for its esthetic qualities. The structure, now nearly three-quarters of a century old, adequately carries modern rail and highway traffic.

To the credit of the engineering profession is the fact that men with the genius to conceive, and the nerve to carry this great work to a successful completion, so designed the structure that a large increase over original loads could be safely carried. In fact, Captain Eads stated that if the arches contained but one-half the steel that forms them they would be adequate to carry a far greater load than that for which they were designed.

Eads bridge has three steel arch spans, the central one 520 ft long and the two side spans 502 ft each. The arch spans are composed of four fixed braced ribbed arches spaced transversely $16^1/_2$, 12 and $16^1/_2$ ft. Each arch has two 18-in. constant-diameter ribs, or tubes, spaced 12 ft apart vertically and tied together by a single web system of eyebars. The arches are braced transversely by pipe struts and adjustable rods. The ribs, made up of six chrome steel staves with ultimate strength of 120,000 psi, are banded together by a wrought-iron envelope. Over 6,000 of the staves, each pretested to 50,000 psi in compression, were used in the bridge.

The limitations imposed by the steel manufacturers, fabricators and erection equipment of 1870 dictated the use of short structural members. A panel length of 12 ft thus adopted resulted in a profusion of joints and a multitude of surfaces in action. On the three main spans that comprise 1,627 ft of bridge, there are

RAPIDLY DETERIORATING timber decking is removed and loaded onto gondolas on track below. Wrought-iron floorbeams supporting timber deck are replaced by steel girders (right background), which are welded to original wrought-iron columns.

TWO LANES ARE KEPT OPEN to highway traffic during construction. One railroad track, on lower deck, is in continuous use and other track is used outside of working hours. Steel decking, $4^1/_2$-in. I-Bm-Lok, (left) is welded to new steel floorbeams spaced about 6 ft on centers. Haydite aggregate concrete (right) is placed in first 12-ft lane of steel decking by transit-mix truck. Portable gasoline vibrators in foreground work concrete into mesh of decking.

1,048 splices of main members, some of which have a reversal of stress with the passage of each train—fortunately there are few such members and they are not highly stressed. Although the many surfaces have been subjected to nearly three-quarters of a century of service and weather, there has never been a loose joint or connection of a main member, or signs of fatigue, distortion or wear. The care exercised by Eads in every detail of the building of this masterpiece makes it, after 75 years of progress, an admirable example of thoroughness of design and precision of fabrication and erection.

Construction of the new highway deck, substituting new steel floorbeams with I-Bm-Lok decking for old steel and wrought-iron floorbeams with timber stringers and decking, was done through necessity and not choice. Fully 90 percent of the floorbeams needed replacement; the timber stringers were softening and failing rapidly at bearing points; and the wind truss was so badly corroded that its value was highly questionable. Stability of the timber decking in a strong wind depended almost en-

CONSTRUCTION OF NEW DECK—two lanes of which are shown here in service—increases clear width of roadway from 38.5 ft to 41 ft. Sidewalks are decreased from 6 ft to 4 ft. Elevation of deck is lowered 39 in. at center of center span and raised 9 in. at end of side spans. Clearance over railroad track of lower deck is increased from 16.5 ft to 18 ft on all spans.

SOME PERTINENT FACTS ABOUT EADS BRIDGE

Original design stresses were 30,000 psi in compression and 20,000 psi in tension.

Mathematical and detail design work for original construction was performed by Col. Henry Flad and Mr. Charles Pfeifer, who were later Commissioners of the City of St. Louis, and the fathers, respectively, of Mr. Edward Flad, consulting engineer and member of the Mississippi River Commission, and the late Mr. Herman Pfeifer, former chief engineer of the Terminal Railroad.

Col. Milner Roberts was associate chief engineer during construction.

Eads bridge made the first extensive use of steel for bridge construction in America. The items "modulus of elasticity" and "elastic limit" were used in specifications for steel, for the first time, by Captain Eads.

Piers were sunk by the pneumatic caisson method, the first such work in America. Men worked under 49-lb pressure, and there were 14 deaths due to the bends.

Closing members of arch ribs, adjustable in length, were placed and screwed out to design dimension.

Safe working stress for main members is considered to be 40,000 psi in compression—though infrequently, if ever, are any members that highly stressed.

Center span rises and falls at its center 8.7 in., more or less, with 80-deg change in temperature.

Temperature stresses may go as high as 6,000 psi, wind stresses (for 100-mile wind) up to 2,500 psi.

Bridge is stronger in hot weather than in cold because temperature stresses are additive in cold weather and subtractive in hot weather.

Mr. James Andrews of Pittsburgh, contractor for masonry, employed up to 1,500 men on this project.

Andrew Carnegie was subcontractor for steel and fabrication, and an official in the Keystone Bridge Co. that erected the steel.

Arches were erected without falsework, with the use of tie-back cables. Any member of the bridge can be removed and replaced without falsework or tie-back cables.

FIRST 12-FT LANE of new roadway is opened to traffic while old timber decking at right is still in use. Sections of steel decking at left are to be placed in open area at center. New decking reduces dead-load weight of three spans by 1,200,000 lb, or 810 lb per ft of bridge.

tirely on its weight. Portions of the floorbeams were those originally placed by Captain Eads. Considering their loss in sectional area, it was amazing that they could carry 20-ton truck loads.

Based on a symposium of suggestions the following three plans were developed for the necessary rehabilitation work:

Plan I. Make repairs and renewals in kind.

Plan II. Construct a complete new highway floor system with I-Bm-Lok decking.

Plan III. Construct a new highway arch bridge superimposed on the present piers and entirely independent of the present arches and railway deck.

Plan II, considered to be the most feasible and least expensive, was adopted. The late Philip J. Watson, president of the Terminal Railroad, approved the plan and directed that work be started in June of 1946, but delays in steel deliveries necessitated postponement of completion until spring of this year. No appreciable delay in the steady flow of highway traffic during reconstruction of the highway deck was reflected at the toll house. Contractor for erection was William J. Howard, Inc.

This paper is based on a talk before a recent luncheon meeting of the St. Louis Section of ASCE.

Improved Welding Techniques Increase Use of Radiant Heating

TEN YEARS AGO radiant heating in the United States was a method of space heating mentioned briefly in scientific books. There were only four recorded installations in the country. No practical information on the subject was available. Today, there are upwards of 10,000 installations and nearly a thousand new ones are being made monthly, according to A. M. Byers Co., Pittsburgh, Pa., which has compiled technical data on individual installations since 1937.

An analysis by Byers' engineers of 1,000 installations surveyed shows that 93 percent use floor-type radiant heating coils. There were no projects in which wall coils exclusively carried the heating load, but a few installations had wall panels as supplementary heating elements. In a number of buildings, both floor coils and ceiling coils were used—these were principally multiple-storied structures where floor coils were used in the first floor and ceiling coils in the other stories.

As important as the rapid increase in the number of installations is the fact that radiant heating has been used in virtually every type of structure, both private and government owned, in every part of the country. These include homes in all price ranges, and commercial, industrial, and institutional buildings.

The floor-heating method has eliminated many of the problems inherent in basementless construction, such as dampness and cold drafts. Therefore it was accepted more rapidly for such structures as garages, aircraft hangars, factories and one-story houses which have floor slabs built on grade. That the system is just as practical for multi-story buildings has been proved by installations in buildings up to eight stories high.

IMPROVEMENTS IN WELDING techniques and increased number of qualified welders trained during war years are big factors in rapid growth of industrial, commercial and residential radiant heating installations. Here, welded wrought-iron coils for residence (left) are placed on crushed rock base prior to pouring of concrete slab. Concrete slab (right) envelops welded wrought-iron radiant heating coils for garage and service station installation. Same boiler supplies hot water for coils embedded in driveway for snow removal.

Engineers' Notebook

Scientific Approach Reveals Fallacies in Paradoxical Engineering

S. F. BORG, ASSOC. M. ASCE

Assistant Professor of Aeronautical Engineering, Postgraduate School, U.S. Naval Academy, Annapolis, Md.

AMONG THE MOST interesting of the paradoxes known to engineering science are those which have been used as the basis for the design of so-called perpetual-motion machines. For example, not too many years ago a patent application was submitted for a baggage carrier which, it was claimed, would carry freight and baggage without power input. The machine was simply a double cone running on horizontally divergent guides set on an incline. It is known that the cone will, of its own power, run "up" the guides (Fig. 1). Why not make use of this paradox for practical, commercial purposes?

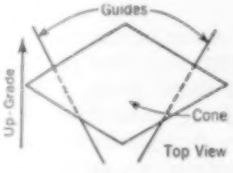


FIG. 1

A student of elementary physics could have pointed out the fallacy in this alleged perpetual-motion principle. It could be shown quite easily that although the cone rolls up the guides, the center of gravity of the machine must be lowered thereby. This distinguishes the machine in no way from an ordinary barrel rolling down an inclined plane—surely not a perpetual-motion machine.

Another "perpetual-motion" apparatus for which a patent application was submitted is shown in Fig. 2. It was stated in the patent application that a quart of water in (*a*) would force the lighter weight in (*b*) through the tube back into (*a*). Hence perpetual motion! We are told that the would-be inventor was amazed when a model showed that the water level in (*b*) was the same as that in (*a*), a fact which students of hydrostatics recognize as following from Pascal's paradox.

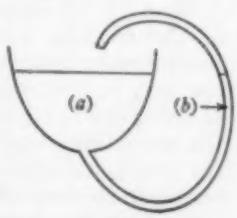


FIG. 2

About 200 years ago D'Alembert analyzed the pressure distribution on an obstacle in a uniformly flowing inviscid fluid and discovered the paradox which has since been given his name—that the resultant force on the body is zero! If this is true for air, it should be possible to start an object moving therein and, since the resistance is zero, it would move forever—again, perpetual motion. However, air is not an inviscid fluid and consequently objects moving in air do offer resistance to motion.

One more example of a "perpetual-motion" machine which may be analyzed by the methods of mechanics is the Roberval balance, Fig. 3. The four sides are pinned at the ends and at the center post. The weight arms are rigidly attached to the vertical bars. The paradox is that regardless of the positions of the loads P on their arms, the structure will be in balance. To this day perpetual-motion machines are being designed on the principle that a load P properly placed on its arm will move down while the other load moves up. However, it may be seen that regardless of the load positions, if one load moves down a distance a, the other will move up the same distance. Hence the net work must equal zero, and there is no tendency whatever for either load to move, in any position.

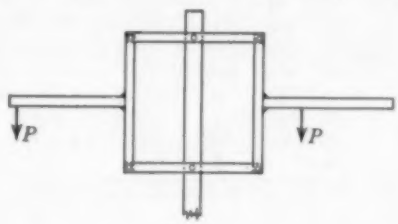


FIG. 3

One of the most famous structural paradoxes was discovered by Emerson about 200 years ago and has since been known as Emerson's paradox. Consider a beam of equilateral triangular cross-section subjected to a 25,000 in.-lb moment. For this beam, Fig. 4 (*a*), the maximum bending stress is given by:

$$s = Mc/I = 8{,}000 \text{ psi}$$

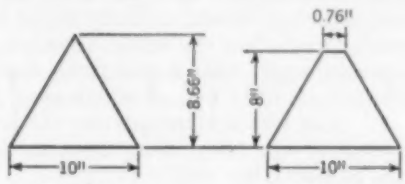


FIG. 4(*a*)

FIG. 4(*b*)

Now assume some material removed from the top of the beam so that the cross-section is as shown in Fig. 4 (*b*). For this beam the maximum bending stress is 7,400 psi. Does this mean, as Emerson claimed, that the beam of Fig. 4 (*b*) is capable of carrying more load than the beam of Fig. 4 (*a*)? Is a part stronger than a whole, as Emerson claimed it was?

Is a Part Stronger than the Whole?

About thirty years ago Robins Fleming disputed this conclusion. In his paper, Mr. Fleming discussed, among others, the two cases which follow, both of which are typical of eccentric-load structural paradoxes.

First, a column post was specified to be 12×12 in. in cross-section. The builder had no 12×12's but used a 12×16-in. post, as shown in Fig. 5. The maximum stress in the 12×12-in. post would be 800 psi. For the 12×16-in. post it is 1,050 psi. Does this mean that if 4 in. is sawed off the post the remaining 12-in. post would be stronger than the 16-in. post? Is a part stronger than a whole?

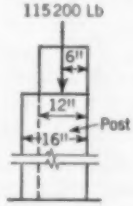


FIG. 5

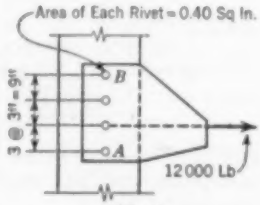


FIG. 6

As the second example, consider the riveted joint shown in Fig. 6. The maximum rivet stress is at rivet A and equals 12,000 psi. If rivet B is removed, the maximum rivet stress will be 10,000 psi. Does this mean that the connection will be stronger with the rivet B knocked out? Is a part stronger than a whole?

The three cases just considered are typical examples used to further the paradoxical claim that a part of a structure may be stronger than the whole structure. There can be no doubt that the stresses in the part-structures, as calculated above by formal approximate methods, are smaller than the stresses in the whole-structures. But whether the part-structure would actually fail at a greater load than the whole structure depends upon many practical considerations, only two of which are:

1. The physical properties of the materials—ductility, toughness, modulus of elasticity, etc.
2. The form of the complex stress distribution following initial yielding.

On the other hand, consider the

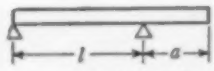


FIG. 7(a)

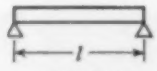


FIG. 7(b)

beams of Fig. 7, loaded only by their own weights. The beam of Fig. 7 (a) is both stronger and weaker than the beam of Fig. 7 (b), depending upon whether the length a is less than "$l/2$" or greater than "$l/2$."

Also, it can be shown theoretically and verified by experiment that the

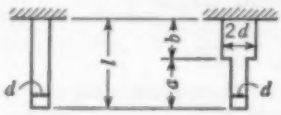


FIG. 8(a) FIG. 8(b)

bar shown in Fig. 8 (a) is capable of absorbing a greater tensile energy load than the bar shown in Fig. 8 (b).

It can therefore be stated that a part may be stronger than a whole, that the mere addition of material does not necessarily strengthen a part. However, this conclusion, as previously pointed out, may not be applied arbitrarily to every problem which raises the question, "Is a part stronger than a whole?"

Additional Paradoxes in Hydrodynamics

In concluding, three final paradoxes will be stated. It will be seen that all three may be explained by the equation of hydrodynamics.

1. A light ball on the flange of the tube shown in Fig. 9 (a) will not be

FIG. 9(a) FIG. 9(b) FIG. 9(c)

blown off by an air jet through the tube. It will simply roll around on the flange.

2. The light circular card, Fig. 9 (b), will not be blown off the circular flange more than a small distance.

3. A light ball set in a conical cup over the air jet, Fig. 9 (c), will not be blown off and will not fall off when the apparatus is held with the cup end down.

Tests Verify Accuracy of Transformed-Area Method of Predicting Beam Stresses

J. TRUEMAN THOMPSON, M. ASCE

Professor of Civil Engineering, The Johns Hopkins University, Baltimore, Md.

STUDENTS OF STRUCTURES will recall that the transformed-area method of predicting stresses in reinforced concrete beams consists of first making the cross-section of concrete and steel homogeneous. This may be done by multiplying the steel areas by the ratio, n, of the modulus of elasticity of steel to that of concrete and substituting these products for the original steel areas. Thereafter, the resulting new dimensions may be used to compute such properties of the section as position of neutral axis (center of gravity) and moment of inertia, and with these properties to predict structural behavior—stresses, deflections, etc.

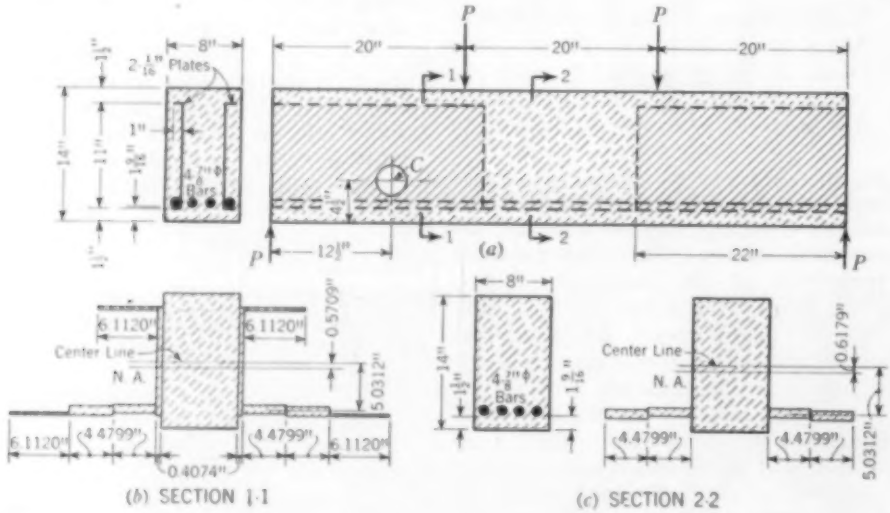


FIG. 1. Part (a) shows dimensions of beams, arrangement of main reinforcement and web plates, and load positioning. Parts (b) and (c) show original and transformed cross-sections 1-1 and 2-2.

Some time ago a graduate student doing research under my direction produced, incident to his main objective, an excellent experimental verification of the accuracy of the transformed-area method of predicting strains. The major results of research appeared in CIVIL ENGINEERING ("Concrete Beams with Sheet-Steel Web Plates," by J. Trueman Thompson, Thomas F. Hubbard, and John N. Fehrer, December 1938, page 815), but the incidental verification has not been previously published. Such verification should increase confidence in all reinforced concrete beam theory. Those interested in the techniques and instruments used in the testing are referred to the article just mentioned.

Figure 1 (a) shows the dimensions of the beams, the arrangement of main reinforcement and web plates, the load positioning, and the location of the point C, where deformations in the web plates were measured. Since the main objective of the research centered on the behavior of the web reinforcement, strains were meas-

ured by gages mounted on the web plates, one on each side of the beams, at point C. Small openings about 2 in. in diameter were made in the outer concrete covering of the plates to permit placing the gages directly on them. These gages could be rotated through 360 deg, permitting a study of components of strain and an experimental verification of the axis of maximum strain.

The combined (principal) stress at any point in a beam may be expressed by $S'_t = S_t \sin^2\theta + 2\,S_s \sin\theta\cos\theta$. Corresponding strain, $\delta = S'_t/E$. For maximum and minimum values of S'_t,

$$\tan 2\theta = \frac{-2S_s}{S_t}$$

Where

S'_t = combined (principal) tensile stress

S_t = unit tensile stress due to bending $= \dfrac{Mc}{I}$

S_s = unit shearing stress $= \dfrac{VQ}{Ib} = \dfrac{V\bar{v}A}{Ib}$

θ = angle which S'_t makes with the vertical, measured in a counterclockwise direction

E = modulus of elasticity

In order to use the foregoing expressions for stress, it is obvious that the following must first be determined:

1. Position of neutral axis (center of gravity)
2. I, the moment of inertia
3. Q, the statical moment

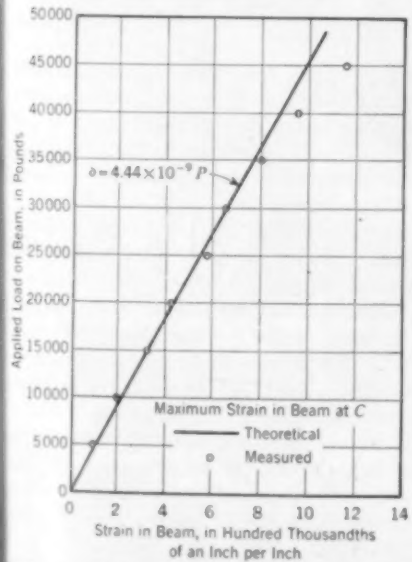

Applied Load on Beam, in Pounds
δ = 4.44×10⁻⁹ P
Maximum Strain in Beam at C
Theoretical
Measured
Strain in Beam, in Hundred Thousandths of an Inch per Inch

FIG. 3. COMPUTED AND MEASURED maximum tensile strains in beams at 57° 15′ (theoretical angle with vertical of maximum tension) are compared at different loadings.

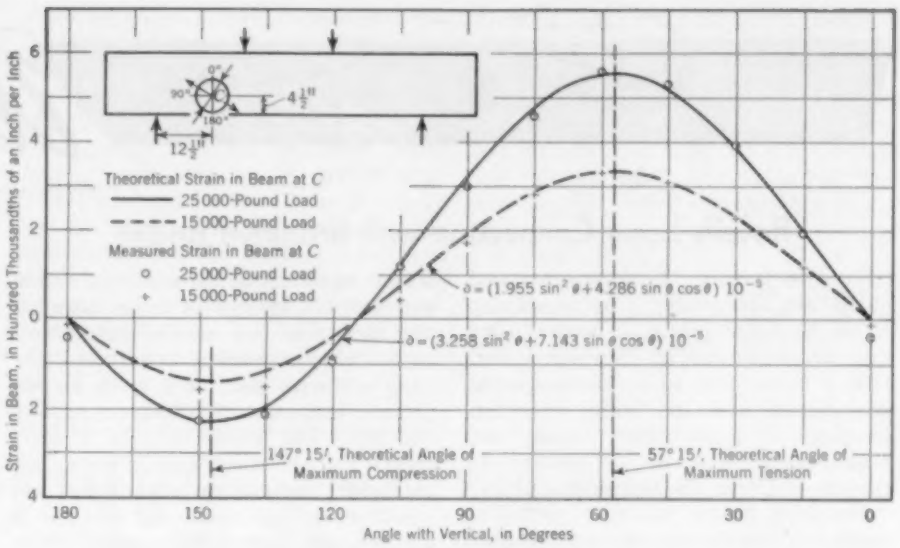

Strain in Beam, in Hundred Thousandths of an Inch per Inch
Theoretical Strain in Beam at C
25 000-Pound Load
15 000-Pound Load
Measured Strain in Beam at C
25 000-Pound Load
15 000-Pound Load
δ = (1.955 sin² θ + 4.286 sin θ cos θ) 10⁻⁵
δ = (3.258 sin² θ + 7.143 sin θ cos θ) 10⁻⁵
147° 15′, Theoretical Angle of Maximum Compression
57° 15′, Theoretical Angle of Maximum Tension
Angle with Vertical, in Degrees

FIG 2. PLOTTING OF AVERAGE measured strains and computed values of strain as function of inclination of axis to vertical shows close conformity.

The original and transformed cross-sections 1-1 and 2-2 are shown in Fig. 1 (*b*) and (*c*). To transform steel to equivalent concrete, measured values of $E_s = 30 \times 10^6$, and $E_c = 3.99 \times 10^6$ were used. Hence $n = \dfrac{E_s}{E_c} = 7.519$ and $n-1 = 6.519$.

The computed position of the neutral axis is shown in Fig. 1. About this axis, moments of inertia were computed, $I_1 = 2{,}318$ and $I_2 = 2{,}178$ in.^{4}. The statical moment about the neutral axis of the area above a horizontal plane extending through the point C, where strain measurements were made (Fig. 1) was found to be: $Q_c = 233$ in.^{3}. The statical moment about the neutral axis was found to be: $Q_1 = 249$ in.^{3}.

Theoretically predicted strains were next computed as follows:

Theoretical strain in beam at point C:

$$S_t = \frac{Mc}{I} = \frac{12.5\,P \times 1.9291}{2{,}318} = 0.01040P$$

$$S_s = \frac{V\bar{v}A}{Ib} = \frac{P \times 233}{2{,}318 \times 8.8149} = 0.01140P$$

$$\tan 2\theta = -\frac{2S_s}{S_t} = -\frac{2 \times 0.01140}{0.01040} = -2.19231.$$

Therefore $2\theta = 114° 30'$ and $294° 30'$

and corresponding values of θ, the axes of maximum and minimum principal stresses respectively, are 57° 15′ and 147° 15′.

Strain at point C is:

$$\delta = \frac{S_t \sin^2\theta + 2S_s \sin\theta\cos\theta}{E}.$$

At the 15,000-lb load,

$$\delta = (1.955 \sin^2\theta + 4.286 \sin\theta\cos\theta)\,10^{-5}$$

At the 25,000-lb load,

$$\delta = (3.258 \sin^2\theta + 7.143 \sin\theta\cos\theta)\,10^{-5}.$$

And $\delta_{max} = 4.44 \times 10^{-9}P$

Although only two beams were tested, the correspondence of comparable measured values was excellent. Average measured strains at point C are plotted in Figs. 2 and 3 along with theoretically predicted strains at this point. Figure 2 shows average measured values and computed values of strain as a function of the inclination of its axis to the vertical, while Fig. 3 compares computed and measured maximum tensile strains at 57° 15′, the theoretical angle with the vertical of the maximum tension.

The close tally of computed and observed values revealed by this example leads to the following conclusions:

1. The transformed area method, used by many writers as the basis for the derivation of the formulas commonly employed in reinforced concrete beam design, has proved validity. This should increase confidence in these formulas.

2. The theory used in predicting combined or principal stresses is likewise valid.

...THE READERS Write

Recalls Long Connection with Brooklyn Bridge

TO THE EDITOR: In commemoration of the 64th anniversary of the completion of the Brooklyn Bridge, it occurs to me that my reflections on the many years that I have been with the bridge—as inspector of steel and bridge inspector-in-charge of construction, repair, and maintenance—may be of interest to readers of CIVIL ENGINEERING.

Brooklyn Bridge was first opened to traffic between New York and Brooklyn on May 24, 1883, fifteen years before consolidation of the boroughs. On that date Chester A. Arthur, President of the United States, cut the ribbon that officially opened the bridge to the public. Fifty years later, on May 24, 1933, Mayor John P. O'Brien cut another ribbon stretched across the south roadway as part of the Golden Jubilee Anniversary celebration. Surely it would be proper to celebrate another anniversary this year in commemoration of the bridge's 64 years of service!

The bridge still rears its mighty Gothic towers above the turbulent waters of the busiest waterway in the world—a visible and tangible symbol of union between the boroughs. Its age-defying cables, with their symmetrical and appealingly graceful curves and stays, make an impressive and romantic silhouette against the sky. The joints may be a little creaky and the stays slightly rusty, but the bridge presents an unparalleled appearance and can still boast that she is prettier than any of her younger rivals up the river!

Long regarded by many as the Eighth Wonder of the World, Brooklyn Bridge is still, in my opinion, the most famous and esthetic span in existence. Furthermore, as a result of a technical survey made several years ago by a board of eminent consulting engineers, the bridge was declared in good physical condition and potentially useful for many years to come.

THEODORE BELZNER, Affiliate ASCE
Brooklyn, N.Y.

Colorado River Water Developments Discussed

TO THE EDITOR: I should like to discuss the abstract, in the May issue (page 13), of a paper presented by Charles A. Carson, Phoenix attorney, before the Irrigation Division session of the Society's Spring Meeting. In a discussion of Mr. Carson's original paper, presented at the same session, I pointed out, without debating the issues involved, that certain of Mr. Carson's statements as to the amount of Colorado River water to which Arizona is entitled under the Colorado River Compact and related statutes and instruments, were based upon Arizona's interpretations of the compact, which differ widely from California's interpretations; that all questions as to the amount of Colorado River water available for use in Arizona remain for future determination; and that Mr. Carson's statements in such respect should be regarded as the expression of a hope rather than as a settled or inescapable fact.

Bureau of Reclamation studies and investigations of the Central Arizona Project have not as yet shown that the project is, or will be, a feasible undertaking. In the first place, there has been no showing of an adequate and dependable water supply physically and legally available for the project, as outlined in Mr. Carson's paper, and no such showing can be made until there has been a determination of the respective rights of the Lower Basin states to Colorado River water under the terms of the Colorado River Compact, the Boulder Canyon Project Act, and related documents and instruments. Obviously this is the first prerequisite to the engineering feasibility of an irrigation or water supply project.

Secondly, preliminary studies and reports of the Bureau of Reclamation clearly show that the project is not economically feasible under existing reclamation law. The Bureau's preliminary financial studies reveal that, even after assuming that the interest component on the commercial power investment can properly be credited as an annual return to repay the capital cost of irrigation (the propriety of which is open to serious question), the returns would be insufficient to repay reimbursable costs. These preliminary studies also show that the project cannot be financed without a very substantial subsidy from the federal treasury, in addition to the presently allowed non-reimbursable costs, far beyond that comtemplated under existing law.

Mr. Carson's statement, quoted in the abstract—that the state of Arizona is "not asking for grants from the federal treasury. All of the costs except those allocated to flood control and similar purposes, which customarily are made non-reimbursable, will be repaid directly to the federal treasury through charges for electric energy and charges for the delivery of water"—is not supported by the preliminary studies thus far made by the Bureau of Reclamation. Neither is his comment that, "the bill pending before Congress is a sound investment."

The State of California recognizes fully that Arizona and California constitute one trade territory and should be developed together, to the maximum extent consistent with prudent estimates of water supply and sound financing. California expects, however, that the government will not enter upon the construction of great projects that will overdevelop the water resources of the Colorado River and spread the water too thin. That practice has already brought hardship to too many Western irrigation projects.

The unfortunate situation to be faced is that the water supply, which can be made available under full development for use in the Lower Basin, will not be sufficient to meet the water requirements of existing and authorized projects in Arizona, California, and Nevada and the Mexican Water Treaty burden and, at the same time, provide for any additional new projects such as the Central Arizona Project. Mr. Carson's paper does not recognize the fact that the Central Arizona Project, as proposed, conflicts with existing operating projects for use of Colorado River water in California, as well as existing and authorized projects in Arizona.

California projects are based, in large part, on water appropriations (among the earliest on the river), supplemented by contracts with the United States under the terms of the Boulder Canyon Project Act. The works are already built and in operation, and California agencies have investments and commitments in them in excess of $500,000,000. On these projects depend the irrigation of 1,000,000 acres and domestic and industrial water supply for a present population of over 4,000,000.

RAYMOND MATTHEW, M. ASCE
Chf. Engr., Colorado River Board of California
Los Angeles, Calif.

Arizona Section Benefits from Society Publicity

DEAR SIR: All of us enjoyed having the ASCE visitors here during the 1947 Spring Meeting of the Society.

For many years members in isolated Sections like the Arizona Section have felt that we were neglected. But since the Spring Meeting, when all the local members had an opportunity for direct contact with the Board and executive staff, we now understand that we are as much a part of the Society as members in the more populous areas.

We were particularly gratified with the favorable results secured by Mr. Allen Wagner in presenting the affairs of the Society to the public by the medium of the press and radio. For many years the Arizona Section engineers have labored on projects of considerable magnitude, and for these years the credit for the projects has been given to the politicians and the bankers who were more in touch with public affairs. Since his visit and his handling of public relations here, at least a dozen people have expressed surprise that the public was not better informed, prior to the Spring Meeting, concerning the participation of Arizona Section members in projects of magnitude in this area.

Work of this type assists us to a large extent, because many of us realize that in engineering we must not only conceive and design adequate structures, but must also be able to present our case to the public.

JOHN GIRAND, Assoc. M. ASCE
Chairman, Publicity Committee for Spring Meeting

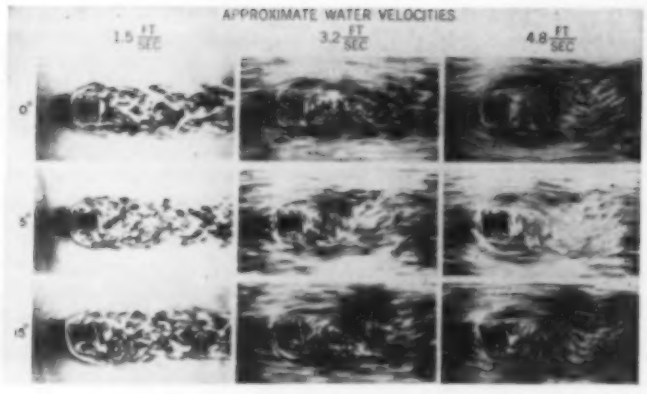
Phoenix, Ariz.

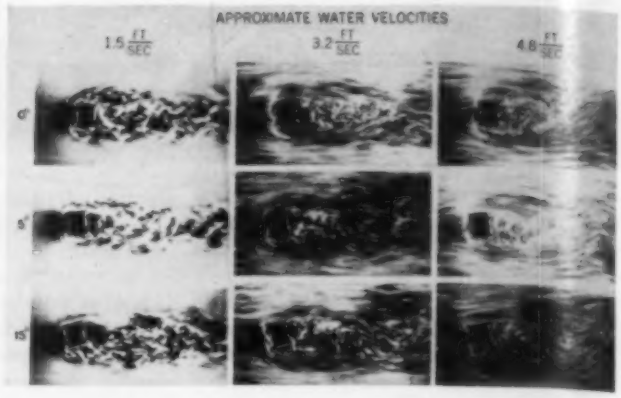
Describes Early M.I.T. Tests of Tacoma Bridge Failure

DEAR SIR: The writer was very much interested in John H. Dawson's letter to the editor in the May issue of CIVIL ENGINEERING. It recalled exactly similar tests conducted at Massachusetts Institute of Technology at the writer's instigation in connection with early studies investigating the failure of the Tacoma Narrows Bridge. These tests were made in August 1941 by Walter F. Hiltner, Jun. ASCE, and Dr. Davis R. Dewey II. The method was exactly the same as that used by Mr. Dawson, but the model was a more exact representation of the Tacoma section in that it included the stringers. Fluid velocities ranging from 1.5 ft/sec to 8 ft/sec were used and seven different angles of attack (Fig. 1).

Very pronounced vortex formations were noted at the higher velocities, and a complete color motion picture record of them was obtained. At the same time a series of typical structural sections were photographed at various angles of attack

FIG. 1. FLUID VELOCITIES RANGING from 1.5 ft/sec to 8 ft/sec and seven different angles of attack are used in Tacoma Bridge model tests.





FIGS. 2 AND 3. TYPICAL STRUCTURAL section is photographed at various angles of attack in Tacoma Bridge tests.

Photographs of one of these sections at various angles of attack are shown in Figs. 2 and 3.

The tests were conducted as part of a series of studies which included hot-wire investigations of the rate at which the vortex was shed from a section of the Tacoma bridge in air, both in the static condition and while the model was oscillating. As a result of these and certain similar tests—conducted under the auspices of the Washington Toll Bridge Authority and the Public Roads Administration at California Institute of Technology, under the direction of Dr. Theodore Von Karman, M. ASCE—a theory, similar to that proposed by Dr. Steinman in the January and February issues of CIVIL ENGINEERING, was abandoned in favor of a vortex excitation.

It appeared that on a girder-stiffened section of the proportions of the Tacoma Narrows Bridge the initial excitation was of a subharmonic nature— that is, the vortex was discharged at a rate which was some integral multiple of a natural frequency of the bridge. After the oscillation was definitely established, the section appeared to control the vortex which then discharged at the same rate as the oscillation.

The streaming birefringent properties of certain types of bentonite provide a very flexible method for investigating fluid flows which deserve more attention in our fluid flow laboratories.

F. B. FARQUHARSON, M. ASCE

Director, Eng. Experiment Station, Univ. of Washington

Seattle, Wash.

Says Engineering Demands the Highest Integrity

TO THE EDITOR: Professor Harding's article on engineering education, in the June issue, impels me to consider the broad subject of education in its application to all phases of living as well as to engineering. In discussing any subject, one should be sure that the terms discussed are perfectly clear. Many a heated argument cools off when the disputants discover they have different definitions of the words used. Consulting a dictionary, I find that education is defined as "the systematic training of the moral and intellectual faculties." Here in nine words is the key to ultimate success or failure, whether it be individuals, races, or nations concerned.

Because of the abnormal, intensive stress put upon the importance of the scientific, the material and physical element of life, the moral element of education has been practically discarded from our educational curricula and we are beginning to reap the results. We have sown the wind and are reaping the whirlwind.

In my opinion, the engineering profession has an advantage over all other professions in that it demands a higher degree of honesty and integrity in its realm than do any of the other professions. Honesty, basically, is the attribute of character that impels one to do right, regardless of whether such a step might seem the best policy from a human relationship point of view or not. Courtesy and loyalty are inherent in the term. Too often, however, honesty springs from a policy standpoint only. Even if that point of view is dominant, though, the engineering profession is still the most honest.

By this I do not mean that the engineer is more honest than others in his dealings outside his profession. I do mean, though, that in his professional activities he is bound to be accurate and honest, for he is dealing with natural laws—those of gravity, heat, light, and power—where the penalty for violation is almost immediate. In the design of a structure, for instance, if the materials used do not have the strength required to carry the ultimate load, the laws of gravity will at once mete out punishment.

No other profession is so imperative. The lawyer deals with man-made laws, some of which, he soon learns, can be violated with impunity. This does not mean that lawyers, as a profession, are not honest, but merely that there are chances for professional dishonesty that do not present themselves to the engineer. The doctor deals with physical laws which, though immutable, are not clearly defined. Furthermore, the penalty for violation is so far distant and, in many cases, so uncertain, that the doctor must inevitably feel a certain immunity from the consequences of violation.

Regardless of intellectual development and change, the basic principles of life remain the same. Thus the engineer, confronted with almost immediate punishment for violation of natural laws, inclines to be professionally honest. If he is wise, he will carry into his private life the same caution and the same ideals.

JOHN F. MILLER

Euclid, Ohio

Simplified Solution of Vertical Curve Suggested

DEAR SIR: I have read with increasing interest recent issues of CIVIL ENGINEERING containing solutions of the vertical-curve problem and can no longer stay out of the discussion.

The accepted method of this office, as set forth by H. B. Austin, appears to involve less computation than any of the methods presented and may be accomplished with one setting of the slide rule. The solution is accomplished in the following steps:

1. Set the algebraic difference of the grades on the A-scale of the slide rule.
2. Under this on the B-scale set twice the length of the desired vertical curve.
3. Read curve corrections on the A-scale opposite the distance from either

TABLE I. TABULATION HELPS AVOID LABORIOUS COMPUTATIONS

Station	Percent of Grade	Tangent El.	V.C. Correction	Grade El.
558 + 00	−2% 1,000 Ft	579.30	....	579.30
559 + 00		577.30	+0.30	577.60
560 + 00		575.30	+1.20	576.50
561 + 00		573.30	+2.70	576.00
562 + 00		571.30	+4.80	576.10
563 + 00		569.30	+7.50	576.80
564 + 00	+4% V.C	573.30	+4.80	578.10
565 + 00		577.30	+2.70	580.00
566 + 00		581.30	+1.20	582.50
567 + 00		585.30	+0.30	585.60
568 + 00		589.30		589.30

end of the curve on the C-scale.

Example: Using the problem set forth by Mr. Pettijohn et al., we can quickly arrive at the accompanying tabulation. The conditions were a −2 percent grade intersecting a 4 percent grade at station 563 + 00, the vertical curve being 1,000 ft and the elevation of the intersection point 569.30.

In addition to the simplicity of the above solution, intermediate and odd points may also be read at the same setting without any laborious computation.

J. C. Postlewait, Jun. ASCE
Austin Engineering Co.

Peoria, Ill.

Suggests Contributions for Underpaid Faculties

To the Editor: The response to the writer's recent plea for public consideration of salary increases for instructors in institutions of higher learning (page 46 of the March issue of Civil Engineering) has been unexpectedly great. Much of that response logically resolves itself into the query: How can colleges and universities afford to pay higher salaries to the men and women who are training the country's future engineers, scientists, physicians, and other experts? The realization is growing that we may heap praise and academic honors on our worthy teachers, but kind words butter no bread for them.

Slowly the public is waking to the fact that our educators are underpaid—and that they have been underpaid for years. Sooner or later the public must accept the crucial fact that if we are to maintain a high level of scholarship in our college faculties, higher salaries are necessary. If we want assurance that our professional men of the future are being capably instructed, then we must see to it that salaries compatible with our teachers' abilities and needs are paid.

So we face the question: Where is the money coming from? A few of our universities are patently well off—that is, their corporate funds are sufficient to pay what their instructors are worth. It is the less wealthy, but none the less worthy, colleges whose faculties are underpaid.

It is time to educate the average American about education and its costs, beyond the mere tax schedule of his own home town. I suggest that a national educational day or week—whichever may be determined best—be set aside for the purpose. Perhaps the National Educational Association of the United States could take a hand in the matter. Such a day or week should be devoted to collecting voluntary subscriptions to a salary fund, to provide for salary increases in accredited institutions in need of such assistance. This fund would be administered by a committee of properly qualified men and women.

The details of establishing and operating such a fund would not be difficult to work out. However, let us face some of the objections that will arise:

1. The American public is weary of collections. That objection is voiced every time an organization of national importance approaches the public with a request for money. However, the collections prove that although John Doe grumbles, as he always will about such things, he has contributed handsomely.

2. From their ivory towers, some will object that such a drive for funds would give education the appearance of begging in the streets, and this to its utter shame. The answer is that the shame rests upon us, the men in the street, and that it is high time we tried to remove the injustice of inadequate salaries for our educators and make the way easier for them.

3. Many will ask how money thus collected will reach the deserving and underpaid teachers. Also, won't some stigma attach to the colleges to which the money is sent? I will wager that any number of capable men of proved character and wisdom will gladly serve on any committee in any way connected with the raising and administration of such a fund, thus guaranteeing an equitable treatment of all colleges. Most colleges accept funds for foundations and scholarships and other purposes, and the fund derived from the suggested drive would doubtless be fully acceptable to them.

4. It may well be argued that too great an amount of work will be entailed in establishing an organization adequate to make the collection. I can only say that the American Red Cross, the Infantile Paralysis Foundation, and many other organizations are operated largely by volunteer personnel.

Such an appeal as that outlined, made annually to the public, will help people evaluate education and the educators. It will focus attention on the accomplishments of the teachers, as well as the colleges. It is true that we don't appreciate the things we get for nothing. Parent-teacher associations have been instrumental in securing some recognition for public school teachers, but college teachers can expect assistance only from an appreciative board of trustees, if funds exist to provide it.

Better salaries for instructors, made possible by voluntary contributions from the general public, will have a lasting psychological effect for the good of each contributor and of the nation as a whole.

L. H. Berger, M. ASCE

Boston, Mass.

Method of Computing Curves Called Quicker

Dear Sir: I was interested in Professor Barnes' discussion on vertical curves in the April issue. A method of computing vertical curves that I used long ago is, in principle, exactly the same as his method, and this principle seems to me so simple and obvious that, like Professor Barnes, I have wondered why it is not more widely used.

However, in my method I introduced a variant which I adopted after some experience—that is, to begin every curve at a full station, letting it end where it may. This obviates the use of subchords (or fractional chords), and so is slightly quicker than Professor Barnes' method. In other respects, it is equally good.

Edward Gray

Washington, D.C.

Cooperation on Tests of Bridge Sections Offered

Dear Sir: Readers of Civil Engineering may be interested to know that, as a result of my article in the January issue, four institutions have already offered to cooperate with me by making the desired aerodynamic tests of bridge sections. These institutions are New York University, Pennsylvania State College, the University of Iowa, and Brooklyn Polytechnic Institute. These are in addition to the tests that are being made for me at Virginia Polytechnic Institute.

D. B. Steinman, M. ASCE

New York, N.Y.

Suggested Vertical Curve Held Easy of Solution

To the Editor: The solution to the vertical-curve problem, submitted by "The Old Cowhand" in the April issue of Civil Engineering, is amusing to one who for 25 years has computed thousands of these curves, in lengths from 50 to 3,000 ft. For his illustration he uses one of the simplest curves, which could almost be worked in one's head.

As a matter of fact, most of us who are computing vertical curves need no handbook or field manual. The formula of one-eighth the algebraic difference in grade percentages times the number of 100-ft chords for the P.I. or center correction should be easily remembered. Then the formula of distance from the beginning or end of the curve to the station to be computed over the half length of curve squared is not as difficult as it sounds.

In the old cowhand's example of curve, the first distance is 50 ft, the second 100 ft, and so on. The first distance is, therefore, 50 over 500 which, reduced to a common denominator, is one-tenth; the second is two-tenths, and so on. These computations, continued in 50-ft stations, will make the upper part of the fraction 1, 2, 3, 4, 5, 6, 7, 8, and 9 (and even 10 for the center), and these numbers are easily squared. The center correction would be (−2) plus (+4) equals 6 divided by 8, equals 0.75 times 10 (number of 100-ft chords) equals 7.50 ft. Divide the center correction by 10 squared (100) equals 0.075, and multiply 0.75 by the square of 1(1), 2(4), 3(9), 4(16), 5(25), 6(36), 7(49), 8(64), 9(81) to find the other corrections of the curve, on both sides of the P.I. These corrections are added to the tangent grade at their various stations.

Obviously one could make most of the foregoing computations without pencil and paper, which need be used only to note the tangent grades, corrections, and stations. Incidentally, there was a typographical error in the tangent grade for the first station shown in the old cowhand's table, which should read 581.30 instead of 581.00.

O. S. Rhodes, Assoc. M. ASCE
Civil Engr., Civil Aeronautics Administration
Decatur, Ill.

Cites Comparisons in Running Vertical Curves

To the Editor: In the recent discussions on vertical curves, involving the computations by grades instead of the squaring of the distance ratios, it was not shown that the "simplified method" is quite similar to the methods used in running in horizontal curves. In fact, the parabolic vertical curve generally used follows quite closely the arc of a simple curve, and the only reason we use the parabola is because it is easier to compute the grade elevations. The method described by W. B. Crombie and others has been used by many old-timers for many years but is evidently not generally known.

Because we are surface dwellers on this planet, we tend to exaggerate surface irregularities, and changes in grade and elevation stand out much more than changes in horizontal direction. In order to acquire a different perspective let us revolve through an angle of 90 deg an average vertical curve that would be found in highway work—a curve 800 ft long to be used between a +4 percent and a −4 percent. As a vertical curve this would seem to be quite an abrupt change. As a horizontal curve we would have an intersection angle of the tangents, or I of 4 deg 36 min. This is a very small intersection angle for a horizontal curve and would so appear to the eye, and if a horizontal curve 800 ft long were run in, it would appear as a very flat curve. In fact, it would be a curve of only a little more than one-half of 1 deg or about 34 min. It is the flatness of these vertical curves that accounts for the fact that they deviate very little from a simple curve.

A parabola is a curve whose second derivative is a constant—that is, its tangent changes direction at a constant rate for equal changes in horizontal distances or referred to an X-Y axis. A circle is a curve whose tangent changes at a uniform rate for equal distances along the curve. If a chain gang in running in a vertical curve in the field do not use a plumb bob, which sometimes happens if the grades are not very steep, they are probably running a simple curve. If the plumb bob is used, it is reasonably certain they are using a parabola. In any case the methods proposed by Mr. Crombie and other discussers, including the "Old Cow Hand," are applicable.

For the purpose of simplification, discussers of the subject have assumed that the intersection of the grade tangents occurs at an even station. Unfortunately this may not always be the case, and the B.V.C. will also be a plus. Grades are figured and stakes set at even stations or even stations +50, if 50-ft chords are used. Assume, in the example cited by Mr. Crombie, that the intersection came at Station 563+60 instead of Station 563+00, and that the elevation of the intersection of the grade tangents was 569.30 as given. Using a 1,000-ft vertical curve, the B.V.C. would fall at 558+60 and the E.V.C. at 568+60, and the elevations at the B.V.C. and the E.V.C. would be the same as given—579.30 and 589.30. The rate of grade change for a station would be +0.60 as given.

Vertical Curve Computation:

Station	Computation	Point Elevation
558 + 60		579.300
	2.00 − 0.12 × 0.40	− .752
559		578.548
	1.88 − (0.12 + 0.30)	−1.460
560		577.088
	1.46 − 0.60	− .860
561		576.228
	0.86 − 0.60	− .260
562		575.968
	−0.26 + 0.60	+ .340
563		576.308
	−0.34 + 0.60	+ .940
564		577.248
	+0.94 + 0.60	+1.540
565		578.788
	+1.54 + 0.60	+2.140
566		580.928
	+2.14 + 0.60	+2.740
567		583.668
	+2.74 + 0.60	+3.340
568		587.008
	3.34 − (0.30 + 0.18) = 3.82 × 0.6	+2.292
568 + 60		589.300 ck.
	3.82 + 0.18 = 4.00 grade on tangent ck.	

In order to set a grade at Station 559+00 the grade for the first 40 ft will be found. This will be one-half the grade change for 40 ft which would be one-half of 0.40 × 0.60 = 0.12, or the grade would be 2.00 − 0.12 = 1.88. Now 1.88 × 0.40 of a station would give 0.752. Going from the subchord of 40 ft to the grade for the next 100-ft full station, we must use half the grade change for the 40 ft + half the grade change for the full 100 ft or 0.12 + 0.30 = 0.42.

This method not only gives a check on the grade at the E.V.C., but also a check on the following grade on the tangent.

J. Maughs Brown, M. ASCE
Director of Roads, U.S. Indian Service
Chicago, Ill.

SOCIETY NEWS

EDITORIAL:

Get Out the Vote

IT BECOMES increasingly evident that most of the Corporate Members of ASCE who have informed themselves regarding the interrelated issues on which they will ballot this fall favor BOTH of the proposed Constitutional Amendments: (1) To enfranchise Juniors; and (2) to increase Society dues. Society officers, Directors and staff members report that they come away from Local Section meetings where they have explained these issues with the distinct feeling that by far the majority of those attending feel that:

> A dues increase is needed in view of increased costs of everything, including all Society functions. A corollary factor is the decreased purchasing power of the Society's income dollars.
>
> It would be undesirable to curtail, much less to abandon, professional activities of the Society, most of which have been undertaken in recent years.
>
> This is particularly true because Juniors, who are enrolling in the ASCE at a much more rapid rate than older members and now comprise about one-third of the entire membership are more closely and continuously affected by those professional activities than are the older members.

But there remains a substantial portion of the Society's membership which has not yet undertaken a thorough study of the problems which led to the proposals. This was pointed up by the Local Section Conference in Phoenix, which adopted a resolution calling the increased cost of Society operations "an emergency" which "will cause curtailment, or possibly abandonment, of necessary professional and welfare activities," and urged further publicity because "the membership is not fully cognizant of this emergency."

Apparently, what those attending the conference had in mind was that many ASCE members do not attend Local Section meetings regularly, and have not heard the issues discussed by national officers, Directors, and staff members. It is feared that members, although they may accept the dues increase as an inevitable result of the general inflationary conditions prevailing, and even though they favor the continuation of present progressive policies of the Society, will not trouble to cast a vote for the amendments.

That, of course, would be an understandable reaction; but it should be borne in mind that for every negative vote there must be two affirmative votes if the amendments are to be adopted, since the ASCE Constitution requires a two-thirds majority of all votes cast in order to make a Constitutional Amendment valid.

As President E. M. Hastings pointed out in a recent letter to Local Section presidents (CIVIL ENGINEERING, June 1947, page 52), "The best interests of our Society and our profession will be served only if a very substantial portion of our entire corporate membership votes on these issues."

It behooves all ASCE members interested in furthering the Society's professional activities not only to vote, but to seek out and inform those who have not yet studied the issues, and to get out an informed vote.

Press Hails Plan for Engineering Research

AN ASCE PROFESSIONAL ACTIVITY—to have engineering research included in the research contemplated under the National Science Foundation proposed in federal legislation which has been under consideration some two years—is bearing fruit.

How far the ASCE efforts have progressed since Engineers Joint Council dispatched a panel to Washington at the instigation of ASCE late in 1945 is evidenced by the reception the press recently gave to the Senate's approval of the National Science Foundation bill. Hailing the overwhelming vote—79 to 8—and the need for the proposed annual expenditures of 20 to 25 million dollars on research, particularly in the interest of national defense and security, the press generally expressed the hope that the House also would approve the measure.

Of particular interest to engineers, however, is the fact that engineering research was prominently mentioned among the much-needed varieties. In fact, some publications, including *Time* magazine, listed engineering first in describing the purposes of the legislation.

For background on this legislation, articles in CIVIL ENGINEERING are recommended. See May 1947, page 53, and December 1945, page 572.

Lehigh Valley Section Has 25th Anniversary

TO CELEBRATE THE 25th anniversary of its founding—in June 1922—the Lehigh Valley Section of the ASCE has issued an interesting anniversary brochure. In addition to usual yearbook features, the booklet contains a résumé of Section activities for the whole 25-year period and a complete directory of membership for the period.

A special page pays tribute to M. O. Fuller, M. ASCE, who has the unusual record of having served as secretary-treasurer of the Section for the full quarter of a century. Professor Fuller, who is on the civil engineering staff at Lehigh University, is honored as preeminently "responsible for the continued growth and success" of the Section and, "in fact, for its very existence." Present officers, in addition to Professor Fuller, are J. W. Pastorius, president, and V. W. Anckaitis and E. L. Durkee, vice-presidents.

Engineers Freed from Enforced Unionism with Overhauling of Wagner Act

E. L. CHANDLER, M.ASCE
Eastern Representative, ASCE

EMANCIPATION OF engineering employees from compulsion to join labor organizations not of their own choice has been achieved, after long and arduous efforts, with enactment into law of the Labor-Management Relations Act, 1947. This Act, which overhauls the 12-year-old National Labor Relations Act, or the Wagner Act, as it was more commonly called, became law when both the Senate and House passed it as a compromise for bills each previously had enacted and it was repassed over President Truman's veto by the necessary two-thirds majority in both houses of Congress.

Legislative Efforts Reviewed

After several years' study, an attempt was made last year to bring about amendments to the Wagner Act in the interests of professional employees but, owing to the course of events, it was found inappropriate to press the matter at that time. However, ground work was laid then which was very helpful in reaching the accomplishments of the recent campaign.

Provisions in the 1947 law relating specifically to professional employees were based on the statement of policy adopted by the Board of Direction of the American Society of Civil Engineers. This statement is as follows:

(1) Any group of professional employees, who have a community of interest and who wish to bargain collectively, should be guaranteed the right to form and administer their own bargaining unit and be permitted free choice of their representatives to negotiate with their employer.

(2) No professional employee, or group of professional employees, desiring to undertake collective bargaining with an employer, should be forced to affiliate with, or become members of, any bargaining group, which included non-professional employees, or to submit to representation by such a heterogeneous group or its designated agents.

(3) No professional employee should be forced, against his desires, to join any labor organization as a condition of his employment or to sacrifice his right to individual, personal relations with his employer in matters of employment conditions.

In order to place the views of engineers before the Congress, a special panel was formed, under the auspices of Engineers Joint Council, to appear before committees of the Senate and the House. The panel was composed of one representative each from AIChE, AIEE, ASCE, ASEE, ASME, NSPE, and EJC. The American Institute of Architects presented a statement to each committee and a representative of the Institute appeared with the panel. A statement supporting the amendments was presented in behalf of the American Chemical Society, although no member of that organization appeared in person. Thus, the total membership of the participating societies totals nearly 150,000.

The profession is particularly indebted to Senator Joseph H. Ball and to Congressman Carl Hinshaw, Assoc. M. ASCE, for their sponsorship of legislative bills which recognized the need for special treatment of professional employees under the labor laws.

Professional Employees Recognized

Senator Ball displayed an active interest in, and appreciation of, the needs of professional employees, and his bill, S. 360, included a definition of "professional employee" and other provisions in conformity with the policy statement of the Society. The bill also included many other proposed amendments to the Wagner Act.

In the House, Congressman Hinshaw introduced H.R. 1754 which was a bill containing nothing but proposed amendments in accordance with the policy statement. As a result of action by the House Committee on Education and Labor, an overall bill, H.R. 3020, was introduced and passed the House by a very large majority vote. This bill did not carry any definition of professional employee but did make provision for the creation of bargaining units composed solely of professional employees. Obviously, the lack of a suitable definition would have resulted in confusion in administering a law based on that bill. However, the fact that some special recognition was given to professional employees was encouraging. Some members of the House Committee did not appear to have any real understanding of the problems confronting professional employees, and it is altogether probable that without Congressman Hinshaw's bill, and his active support, the status of professional employees would have been completely ignored in the House and might not have been recognized in later action.

The Senate Committee on Labor and Public Welfare reported its own bill in

Photo, Courtesy Press Association Inc.

PANEL OF ENGINEERS explains engineers' viewpoint on labor legislation to committees of both Houses of Congress. Members of panel are left to right: W. I. Burt, vice-president, B. F. Goodrich Chemical Co., Cleveland, representing American Institute of Chemical Engineers; Ritchie Lawrie, Jr., consulting engineer, Harrisburg, Pa., representing National Society of Professional Engineers of which he is president; Clark W. Ransom, General Electric Co., Pittsfield, Mass., representing American Institute of Electrical Engineers; Hon. Carl Hinshaw, M.C., Assoc. M. ASCE, who introduced House bill; Edmund R. Purves, director of public and professional relations, American Institute of Architects; William F. Ryan, Stone & Webster Engineering Corp., Boston, representing American Society of Mechanical Engineers; Gail A. Hathaway, special assistant to Chief of Engineers, War Department, representing American Society of Civil Engineers; and E. Lawrence Chandler, chairman of panel, representing Engineers Joint Council (also ASCE Washington representative). Other member of panel, not included in photograph, is Dr. Harry S. Rogers, president of Brooklyn Polytechnic Institute, representing American Society for Engineering Education.

the form of an amendment to the House version. This, in turn, was passed by a large majority vote in the Senate.

The bill then went to a Conference Committee and, as a result of insistence by Senate conferees, the resulting compromise bill, known as the Taft-Hartley Bill, carried both a definition of "professional employee" and other provisions guaranteeing independence of action on the part of professionals in the formation of bargaining units.

Professional Employees Defined

The sections of particular interest to professional employees are as follows:

"Sec. 2 (12) The term 'professional employee' means—

"(a) any employee engaged in work (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work; (ii) involving the consistent exercise of discretion and judgment in its performance; (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; (iv) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning or a hospital, as distinguished from a general academic education or from an apprenticeship or from training in the performance of routine mental, manual or physical processes; or

"(b) any employee, who (i) has completed the courses of specialized intellectual instruction and study described in clause (iv) of paragraph (a), and (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (a)."

"Sec. 9 (b) The Board shall decide in each case whether, in order to assure to employees the fullest freedom in exercising the rights guaranteed by the Act, the unit appropriate for the purposes of collective bargaining shall be the employer unit, craft unit, plant unit, or subdivision thereof: Provided, That the Board shall not (1) decide that any unit is appropriate for such purposes if such unit includes both professional employees and employees who are not professional employees unless a majority of such professional employees vote for inclusion in such unit;"

The essence of these provisions is (1) that professional employees are recognized as having problems and aims that are distinct and apart from those of laborers or skilled workmen and (2) that professional employees are guaranteed the right of self-determination, by majority vote of those affected, as to whether they want to refrain entirely from any collective bargaining procedure, whether they wish to have a collective bargaining unit composed exclusively of professional employees, or whether, in any particular instance, they prefer to be included with other types of employees in a heterogeneous bargaining unit.

The above specific clauses, coupled with other requirements of the 1947 law designed to bring about better balanced relationships between all employers and employees, lift professional groups out of the bewildering plight in which they have struggled under the Wagner Act and allow them to conduct their relations with employers in straightforward and professional fashion, with resulting benefit to both.

The ASCE well may be proud of its leadership and consistent efforts in this vital professional activity.

Educators Have Opportunity to Further Scientific Prestige of Engineering Profession

RELATING ENGINEERING TRAINING more closely to the basic sciences that underlie it will be an important step forward in engineering education, according to F. E. Terman, Dean of Engineering, Stanford University, California. His statement appears in the Executive Committee Bulletin of the American Society for Engineering Education—the final issue of the 1946–1947 school season. The printing of this statement in the ASEE bulletin resulted from a discussion among members of the ASEE executive committee on current problems in engineering education. Since Dean Terman's comment on that occasion seemed an excellent summary of the broad problem, he was asked to prepare a written statement for publication, which is reprinted below in full.

A TASK to which the administrators of engineering education can profitably give attention is the development of the scientific prestige of the engineering profession, and particularly of academic engineering work. Especially in schools where the natural sciences are particularly strong, the standing of the engineering portion of the institution often leaves much to be desired.

Unfortunately there is some justification for this situation. Thus the scholarly standards, the length of formal training, etc., that are considered necessary for a teacher of engineering, are usually less rigorous than those required for corresponding academic positions in physics, chemistry, mathematics, biology, etc. In particular, teachers of engineering are often well-grounded in the subject matter actually taught in undergraduate courses, but very poorly grounded in the fundamental science from which this subject matter originates. Again, only a very small percentage of the best engineering students, except those in chemical engineering, carry their studies far enough beyond the bachelor's degree to obtain a training comparable in depth and breadth with that received by the more promising young physicists, chemists, etc.

This is neither necessary nor desirable. In many fields of engineering, as for example, electronics, engineering mechanics, thermodynamics, and fluid mechanics, much of the technical knowledge taught in universities is very close to the basic science on which these fields rest. It is desirable, therefore, that the ablest and more analytical-minded young engineers entering these fields be thoroughly grounded in the pure science that underlies their engineering interests. Such men should be able to contribute more to engineering objectives than the physicists who stray into engineering activities, or engineers whose training has been somewhat superficial.

The present time is unusually favorable for developing these higher aspects of engineering education, and building up the scientific position of the engineer. There are now a large number of engineering students carrying on graduate work with adequate financial assistance, and there is recognition as never before on the part of industry of the value of advanced training. A large government-sponsored research program is being carried out in the country in which many universities are participating, and there is the prospect of a National Science Foundation being formed with an Engineering Division. Thus, many engineering schools are now in a position to develop a program of advanced instruction and research that will operate at a higher level and on a larger scale than would have been considered possible before the war.

Deans and department heads should consciously take advantage of the present

situation to develop the scientific side of the engineering profession. If this is done energetically, and with vision, the result will be the creation of a group of engineer-scientists for industry and for university staffs, that will serve the best interests of the country by filling a hitherto unsatisfied but important need.

Russian Engineer Honored by Metropolitan Section

AMERICA'S LEADERSHIP in the construction industry is largely due to the work of her civil engineers, Nickolai D. Bassov, U.S.S.R. member of the Board of Design of the United Nations permanent headquarters, told guests at a recent luncheon given by the Committee on Hospitality of the Metropolitan Section of ASCE. Speaking in Russian through an interpreter, Mr. Bassov described the Soviet Union's preparation under adverse circumstances for World War II and her present efforts at reconstruction.

About forty leading New York engineers attended the luncheon honoring Mr. Bassov, who is the only engineer on the UN Board of Design, all the other representatives of the various nations being architects. J.P.H. Perry, vice-president of the Turner Construction Co., presided. Col. Max Abramovitz, deputy director of the Board of Design and a member of the architectural firm of Harrison & Abramovitz, and P. Noskov, another Russian associated with the design of the UN headquarters, were introduced to the group.

Member Posthumously Honored by N.Y.U.

AT CEREMONIES HELD on the campus of New York University on May 13, the College of Engineering rededicated its Sanitary Engineering Research Laboratory to the memory of the late Prof. Lewis V. Carpenter, M. ASCE. Professor Carpenter supervised the construction of the building and the operation of the laboratory from its completion in 1937 until his death in 1940.

The laboratory is a unique example of cooperation between a city and a private university. Built by the City of New York on land deeded by the university, the laboratory is operated by the College of Engineering. Priority is given to research projects desired by the City Departments of Sanitation and Public Works.

Speakers at the dedication ceremonies included ASCE Director Thorndike Saville, dean of the college of engineering.

Report on Survey of the Engineering Profession Nearing Completion

PUBLICATION OF the Report on the Survey of the Engineering Profession has been authorized by Engineers Joint Council upon advice of Col. William N. Carey, Executive Secretary, American Society of Civil Engineers, chairman of the EJC Committee on Survey of the Engineering Profession, that the manuscript of the report is practically complete.

The survey, based on a completely precoded mail questionnaire, dates back to 1945, when committee work first was begun. Last August, copies of the precoded questionnaire were mailed to an unduplicated mailing list of the United States resident members of the six national engineering societies participating in the survey—ASCE, AIME, ASME, AIEE, and AIChE, which make up the Council, and NSPE, participating in this project by invitation of Council. Cooperation by the Bureau of Labor Statistics, U.S. Department of Labor, was obtained for utilization of BLS mechanical tabulation equipment. The tabulations furnish the statistical basis for their report, which its author, Mr. Andrew Fraser, the committee's consultant, has titled, "The Engineering Profession in Transition."

Principal objectives of the questionnaire were: (1) To determine the general impact of World War II on the engineering profession in the period 1939 through 1946; (2) to obtain reliable data from which valid findings could be derived to predict the activity pattern of the profession subsequent to the year 1946; and (3) to determine if the war's upheaval had changed materially the pattern of professional activities, educational background and earnings from those which existed in the years prior to 1939.

The report is a statistical analysis of economic factors as they are shown to affect the individual professional engineers who answered the questionnaire. Basic factors analyzed are: Age, sex, year of entering profession, education level and veteran's status. Also covered are factors affecting engineer employment and earning capacity, among which are geographical location, general fields of employment, industrial field and occupational status. Comparisons cover three significant years—before, during and after World War II—1939, 1943, and 1946.

In his discussion of the report with Engineers Joint Council, Colonel Carey stressed the fact that the survey questionnaire was confined to members of the six principal national professional engineering societies. This, he pointed out, assures results providing the absolute minimum of dilution by non-professional persons operating in the engineering field.

"The professional standing of every person included in this survey is amply attested," Colonel Carey said. "Each was a member of one or more of the six national engineering societies participating, and had met successfully the requirements for qualification as a professional engineer.

"The Committee believes that this survey contains a particularly valuable and important feature. It is a survey of the profession restricted for the first time to persons identified through their membership in the six leading national professional engineering societies as being qualified members of the profession."

ON OCCASION of his visit to Oregon Section on tour of West Coast Sections with Executive Secretary William N. Carey following Phoenix Spring Meeting, President E. M. Hastings is presented with birthday cake bearing ASCE seal in full color. At left is ASCE Past-President J. C. Stevens and at right Oregon Section President Norbert Leupold and Colonel Carey.

An Employer Evaluates Membership in ASCE

THE FOLLOWING MEMORANDUM was prepared by Col. W. E. Potter, District Engineer, United States Engineer Department at Kansas City, Mo., for engineer employees of the Kansas City, U.S. Engineer District. It presents an employer's viewpoint regarding the value and the purpose of membership in ASCE. It is submitted as further evidence that realistic employers believe that employees who are members of the Founder Societies of Engineers are likely to be more valuable employees than non-members. Colonel Potter's memorandum, dated November 1946, was sent to Society Headquarters by a Kansas City Member several weeks ago. The message is timely under any date and is recommended reading for all employers of engineers.

MEMORANDUM

Subject: Membership in National Engineering Societies

1. We are employed by the largest engineering concern in the United States and, as a Department of the Government, we are engaged on some of the largest and most important projects designed and constructed by our profession. Each of us should be proud of his chosen profession and should accept every opportunity to improve his professional and technical knowledge.

2. One of the best ways to develop professionally is to supplement our training and everyday experience with technical reading and closer association with other professional engineers. This can be accomplished, at least partially, by active membership in one of the Founder Societies of Engineers—Civil, Mechanical, Electrical, Mining, etc. I sincerely recommend that all eligible engineers in this District become active members of the appropriate national society. Because of the nature of our work, a large number will doubtless be interested in the American Society of Civil Engineers, but mechanical, electrical, or other branches are provided equal facilities by their respective Founder Societies.

3. Those of you who are not members of a Founder Society may be interested to know that these national organizations serve the individual engineer through technical and popular publications, employment services, promotion of helpful legislation, research on special engineering subjects, assistance in labor relations and other functions. Through the Local Sections, such as the civil engineers in Kansas City, members may become acquainted with engineers experienced in varied lines and may hear technical papers in addition to the personal satisfaction of the social contacts.

4. Aside from the personal benefits to be derived, I believe that professional men owe some measure of obligation to their profession as a whole. By identifying himself with a large group and through the medium of dues, *the member engineer provides for the profession an official outlet for information to the public and an official spokesman on matters pertaining to engineering. Such contacts with the public are valuable to the individual engineer, the profession, and the nation at large.* The Founder Societies seek to maintain a high standard of professional ethics and thus assure all employers (and the public) optimum performance on the part of engineers who serve them. I hope that many of you will be interested and will investigate the possibility of Society membership.

W. E. POTTER
Colonel, Corps of Engineers
District Engineer, Kansas City, Mo.

EJC Committee Named to Aid State Department in International Relations

CLOSER LIAISON between the engineering profession and federal agencies devoted to better international relations is the object of a special committee recently appointed by EJC. The committee will be made up of one representative from each of the five constituent societies of EJC. It will be a consultative committee to the State Department and to the EJC Committee on International Relations, of which Malcolm Pirnie, New York, Past-President of ASCE, is chairman.

The Committee was empowered to nominate a representative of EJC to the U. S. National Commission for UNESCO, to which EJC has been elected (see CIVIL ENGINEERING for June 1947, page 59).

The committee was authorized by EJC following the appearance before it of E. Theodore Arndt, of the U.S. State Department, who attended the meeting as an observer representing William Benton, Assistant Secretary of State, who heads the Department of State Division of International Information and Cultural Affairs.

After lauding the cooperation which the State Department has had from the EJC Committee on International Relations and declaring that there is increasing need for liaison between the State Department and the engineering profession, Mr. Arndt told EJC:

"Foreign countries are anxious to find out the U.S. 'know-how.' Requests come in daily for engineering knowledge. These requests are channeled through the State Department, and we would like to have the advice of engineers on how to handle these requests.

"The recent election of EJC to UNESCO (United Nations Educational, Scientific and Cultural Organization) is a step forward to recognize the contribution that engineers can render in the rehabilitation of the world."

Members of the consultative committee appointed are President E. M. Hastings, ASCE, W. E. Wickenden, AIEE, Clyde Williams, AIME, D. R. Yarnall, ASME, and James G. Vail, AIChE. As pointed out by Chairman Pirnie of the International Relations Committee, availability of the members of this consultative committee will be helpful when requests for assistance are made by the Department of State on short notice, for it is expected that with the enlarged personnel, personal assistance of at least some members of the committee will be available at all times. Mr. Pirnie stressed this point in connection with a recent appearance he was called upon to make before the subcommittee of the Foreign Affairs Committee of the House of Representatives. With only 24 hours notice, Mr. Pirnie appeared before the committee and made a presentation on behalf of the engineering profession on HR3342, known as the Mundt Bill, which is a successor to the so-called Bloom Bill. The Bloom Bill failed of passage at the last session of Congress, and the Mundt Bill represents a revision of it which has eliminated the features which were objectionable to the engineering profession.

In his presentation before the House subcommittee, Mr. Pirnie, who followed S cretary of State George Marshall in testifying, stressed the following:

The best properly qualified engineering talent in the country, selected from private business and from government agencies, should be made available to other nations requesting aid of the United States in solving their domestic engineering problems conducive to improved standards of living. Helping other countries to raise their standards of living is the new big frontier. Care must be exercised to avoid any erroneous assumptions by other countries that the technological superiority of the United States which resulted in defeat of the Axis powers should be sought solely in agencies of the government.

Any such assumption is false and dangerous, since the technical superiority of the United States resulted from maximum contribution to the war effort by technologists in private industry and consulting practice, working in full cooperation with technologists in agencies of govern-

ment. In the interchange of American and foreign engineers, extreme care should be exercised, as provided by the Mundt Bill, to point up the completely cooperative efforts between the United States citizens engaged in free enterprise activities and those who have devoted their lives to service in government bureaus and agencies, as contrasted with the practice among other nations in which progress in technology was, and is, directed and controlled by national government bureaus.

Through their experiences in World War II, engineers are convinced that no nation can successfully prosecute a war without calling upon its applied scientists to operate to the full limit of their capacity. There is a corollary to that conviction. If engineers must be depended upon to fight a successful war, they have a commensurate responsibility to work with foreign engineers and governments in all efforts to prevent a future war. They, therefore, seek full cooperation in such programs and will do their best in an unaccustomed field to develop and spread sound information by which they can contribute to the development of better international understanding.

EJC Adopts ASCE Recommendation for Study of National Water Policy

AN ASCE SUGGESTION that the engineering profession take preliminary steps toward establishment of a national water policy has been adopted by Engineers Joint Council. A temporary committee has been authorized, with one member from each of the five member societies of EJC. ASCE President E. M. Hastings has named W. W. Horner, Past-President, as the Society's representative on the EJC committee and has asked three others to assist him—J. C. Stevens, another Past-President, Director Thorndike Saville, and Royce J. Tipton, Past-Director.

EJC action followed recommendations of the ASCE representatives on the council, who had been instructed to make these recommendations by the ASCE Board of Direction at its Spring Meeting in Phoenix. There the Board went on record as considering "the expression and adoption of a national water policy as paramount."

The committee to be appointed by the presidents of the constituent societies of EJC will be a temporary one. Its purposes are: To formulate plans for the proposed investigation and report; to prepare an estimated budget necessary to support the undertaking; to determine the financial participation likely to be obtained from engineering and other societies or organizations concerned with the program to be studied; to explore the feasibility of additional financial support from philanthropic organizations and foundations and the terms thereof; and to present recommendations for the establishment and functioning of a national water policy committee.

Both the ASCE Board of Direction in Phoenix and the EJC made clear that the committee of engineers would serve only to outline ways and means of undertaking the study that will be necessary before a water policy can be established. The committee's work thus will constitute a voluntary contribution by the engineering profession in the form of preliminary steps leading toward the major undertaking. The committee is expected to originate means by which the various federal, state and local agencies charged with the development and control of water can best assist in the formulation of a national policy. The committee also is expected to describe the processes to be used in exploring the various facets of such a national policy, including the extent of the undeveloped water resources of the nation; the conflicts of jurisdiction, planning and execution existing among or between laws and the various agencies; and the effect upon the national economy, welfare and safety of existing laws, and the relation of these factors to other elements of the national economy, such as industry, agriculture and commerce.

"Oldest" Society Members Have Enviable Records

OUTSTANDING ACHIEVEMENTS as well as long periods of membership characterize the fast-dwindling group of living ASCE members who joined the Society in 1890 or before. This group of 30 members includes six Honorary Members (C. Frank Allen, George W. Kittredge, Arthur S. Tuttle, Edwin A. Fisher, Edward H. Connor, and H. S. Jacoby), nine former Directors of the Society (Edward Flad, George W. Kittredge, Arthur S. Tuttle, Edwin A. Fisher, T. Kennard Thomson, George S. Pierson, Edward H. Connor, C. W. Staniford, and R. A. Cummings), and one Past-President (Arthur S. Tuttle).

Dean of the group in length of membership is C. Frank Allen, who also headed the list of those having longest membership records published in CIVIL ENGINEERING for July 1942. Mr. Allen boasts a membership going back nearly 70 years, to 1878. Sixty years later, in 1938, he became an Honorary Member. Second on the list is Edward Flad, who became a Junior in 1885, a Member in 1888, and served as Director, 1911–1913.

Of the 30 members in the "1890 or before" group, the following four joined in 1886: George W. Kittredge, who became a Member in 1886, an Honorary Member in 1931, a Director 1908–1910, and a Vice-President 1917–1918; J. Quincy Barlow, who joined as a Junior and became a Member in 1888; E. E. R. Tratman, who also joined as a Junior, becoming an Associate Member in 1891; and Montgomery Waddell, another who joined as a Junior, becoming a Member in 1896.

Next in seniority on the list are two who joined in 1887: Arthur S. Tuttle, Junior 1887, Associate Member 1894, Member 1898, Honorary Member 1938, Director 1914–1916, Treasurer 1919–1920, Vice-President 1932–1933, and President 1935; and H. G. Darwin, a Fellow since 1887.

The complete list of those surviving members who joined ASCE in 1890 or before, with the date of their first connection with the Society, follows:

Allen, C. Frank '78	Thomson, T. Kennard '89
Flad, Edward '85	Bassett, C. P. '88
Kittredge, George W. '86	Pearl, James W. '89
Barlow, J. Quincy '86	French, James B. '89
Tratman, E. E. R. '86	Pierson, George S. '89
Waddell, Montgomery '86	Miller, Spencer '89
	Harwi, Solomon J. '89
Tuttle, Arthur S. '87	Connor, Edward H. '90
Darwin, H. G. '87	Staniford, C. W. '90
Carroll, Eugene '88	Moses, John C. '90
Tibbals, George A. '88	Quimby, H. H. '90
Tibbals, S. G. '88	Triest, W. G. '90
Tompson, G. M. '88	Cummings, R. A. '90
Fisher, Edwin A. '88	Jacoby, H. S. '90
McCulloh, Walter '88	Davis, Chandler '90
Pratt, M. D. '88	

ASCE Student Chapters Revive Annual Student Conferences

INDICATIVE OF THE fact that the Student Chapters of the ASCE are getting into their prewar stride is the revival of Student Chapter conferences, which were discontinued for the most part during the war. Four recent conferences—the Midwestern Conference, the North-Central Conference, the Philadelphia Section-Lehigh Valley Conference, and the New England Conference—are reported here.

Midwestern Conference

On May 23 and 24 Iowa State College was host to the Third Annual Midwestern Conference of Student Chapters at Ames, Iowa. Registered delegates from Student Chapters at the Illinois Institute of Technology, Northwestern Technological Institute, Rose Polytechnic Institute, University of Iowa, University of Minnesota, and the host Chapter, Iowa State College, totaled 122.

Outstanding events included the Friday evening banquet, at which 230 delegates and guests heard Dr. D. B. Steinman, New York consultant and bridge builder, lecture on aerodynamic forces in bridges, and the Saturday luncheon, addressed by Anson Marston, Past-President and Honorary Member of the Society and dean emeritus of Iowa State College. Dr. Marston reminisced from a wealth of interesting civil engineering experiences.

Other guest speakers were Ailen Wagner, ASCE Public Relations Assistant to the Secretary; Claude Coykendall, administrative engineer for the Iowa Highway Commission; Jack Singleton, chief engineer of the American Institute of Steel Construction; Leo Arms, assistant manager of the Portland Cement Association's Highway Bureau in Chicago; R. A. Moyer, research professor of highway engineering at Iowa State College; and Craig P. Hazelet, consulting engineer of Louisville, Ky., and member of the ASCE Committee on Student Chapters.

At the business meeting, it was voted to hold the next Annual Midwestern Conference at the University of Minnesota in April 1948. The officers elected for the 1948 conference are: Walter Johnson, University of Minnesota, president; Ellis Pickett, Iowa State College, first vice-president; and Norman Pera, Rose Polytechnic Institute, second vice-president. The president of the host Chapter will be secretary-treasurer of the conference.

North-Central Conference

The University of Detroit Chapter was host to a conference of Student Chapters from the north-central area on April 26. The success of the conference, which was attended by 86 delegates from Michigan Student Chapters and the University of Toledo, led to the decision to make the conference an annual affair, to be rotated among the several schools in the area. It is expected that the University of Toledo will be the host Chapter next year. A group photograph of the conference appears on page 64.

Guest speakers included ASCE Mid-West Representative George S. Salter, who discussed current interests and activities of the Society; and Watts Shelly, executive secretary of the Michigan State Board of Registration for Architects, Professional Engineers, and Land Surveyors, who spoke on "The Civil Engineer and Registration." The dinner meeting, culminating event of the day, was addressed by Harold Ellington, Detroit consultant, on the subject of the civil engineer in South America.

The afternoon was given over to inspection trips to the Detroit plant of the Peerless Cement Corp. and the Springwells plant of the City of Detroit Water Supply.

Philadelphia-Lehigh Valley Conference

The Ninth Annual Student Chapter Conference of schools in the Philadelphia and Lehigh Valley Sections took place in Philadelphia on May 5, with the University of Pennsylvania Student Chapter acting as host. The attendance of 149 included delegates from all the engineering schools in the two Sections except Pennsylvania State College and Bucknell University, which were unable to participate in this year's conference.

Presentation of student papers in the annual prize contest, sponsored by the Philadelphia Section, was a feature of the occasion. Contestants were Gerard F. Hofstaedter, of Drexel Institute of Technology; Leon S. Avakian, of Lehigh University; and Charles Scriver, of Swarthmore College. The prize went to Mr. Hofstaedter for his paper on cavitation.

Scheduled speakers included Howard K. Preston, chairman of the Philadelphia Section's Committee on Student Chapters; W. J. Eney, professor of civil engineering at Lehigh University; R. M. Brick, director of the department of metallurgy at the University of Pennsylvania; and F. K. Sharpless, of the Moore School of Electrical Engineering at the University of Pennsylvania.

Following a late luncheon, the conference adjourned for inspection of the differential analyzer and "Edvac" at the Moore School.

New England Conference

ASCE President E. M. Hastings was guest of honor and principal speaker at the New England Conference of Student Chapters, which was held at Brown University, Providence, R. I., on May 24.

IOWA STATE COLLEGE STUDENT CHAPTER is host to 122 delegates attending Third Annual Midwestern Conference of Student Chapters at Ames, Iowa.

NEW ENGLAND CONFERENCE OF Student Chapters, attended by 150 delegates, is entertained at Brown University, Providence, R.I., Host Chapter. Attendance at regional meeting of New England Local Sections concluded all-day program.

President Hastings spoke on Society affairs of special interest to Student Chapter members, and Prof. E. A. Gramstorff, president of the Northeastern Section, spoke on the same theme.

Of great value to the group, most of whom are graduating this year, was a round-table discussion on the general topic, "What the Employer Expects of the Recent Graduate." A panel of well-known New England engineers—Thomas F. Gilbane, Oscar Bray, Philip H. Kittfield, and Carroll A. Farwell—covered the fields of general construction, structures, and highways.

In the evening the group attended the regional meeting of New England Local Sections, to which the Providence Section was host. The attendance of 150 included delegates from all the engineering schools in New England, except those in Maine and Vermont which were prevented from sending delegates because of the distance involved.

New England Sections Have Large Joint Meeting

THE STATUS OF engineers and the increasing opportunities for them to play an important part in modern life were discussed in a talk by ASCE President E. M. Hastings at the regional meeting of New England Local Sections, to which the Providence Section was host, on May 24. Executive Secretary William N. Carey also addressed the dinner, the culminating feature of the joint meeting, on the effect of the ASCE budget on professional progress.

Another highlight of the dinner meeting was the award of the Norman Medal to Dr. Karl Terzaghi, professor of the practice of civil engineering in the Harvard Graduate School, for a paper on "Stability and Stiffness of Cellular Cofferdams," published in Vol. 110 of *Transactions*. Dr. Terzaghi, for the third time recipient of the medal, was in India advising on a reclamation project at the time of the Annual Meeting when the other ASCE prizes were presented. Following receipt of the award, he described his trip to India and explained the work on which he was called into consultation.

Attendance at the dinner meeting included 80 members of the participating Local Sections—Connecticut, Northeastern, and Providence—and 110 Student Chapter delegates assembled in Providence for the New England Conference of Student Chapters. Guests, in addition to President Hastings and Executive Secretary Carey, included ASCE Eastern Representative E. L. Chandler; Director Albert Haertlein; P. G. Laurson, president of the Connecticut Section; E. A Gramstorff, president of the Northeastern Section; and P. W. Brouwers, president of the Providence Engineering Society.

A Navy-conducted inspection trip off Quonset Point occupied the afternoon. A group of 90 members and guests visited the aircraft carrier *Philippine Sea* and aircraft assembly and repair shops and witnessed a demonstration of the use of radar in controlled flying.

It was the consensus of those present that the joint meeting was a great success. Though it was the first regional conference of New England Local Sections, it will not be the last, as tentative plans are already being made to repeat it next year. Frederick H. Paulson, secretary of the Providence Section, headed the committee in charge of arrangements, with Harold L. Blakeslee and Earle F. Littleton, secretaries of the Connecticut and Northeastern Sections, respectively, serving as co-chairmen.

JUNE ISSUE LATE

WE REGRET that the June issue of Civil Engineering was late in getting in the mail. The delay was unavoidable and largely the result of a strike of workmen on an expansion of the printer's plant that is nearing completion.

Former Director Agg Is Posthumously Honored

POSTHUMOUS AWARD OF the Marston Medal to T. R. Agg, former Director of the Society, was made at the recent commencement exercises at Iowa State College. Dean Agg, who died on May 7, 1947, a few months after his retirement as dean of the engineering school at Iowa State College, received the award "in recognition of his achievements in engineering, administration, and research, his writings in the field of engineering, and his activities in the national engineering societies."

Accepting the honor for Dean Agg was Dean Anson Marston, Past-President and Honorary Member of the Society. Dean Marston, donor of the award, was dean of the engineering school from 1904 to 1932.

"Proceedings" Schedule Again on Current Basis

"TECHNICAL PAPERS are now being published in PROCEEDINGS on a substantially current basis," was a statement in the report by the Committee on Publications to the spring meeting of the Board of Direction.

Remarks are sometimes heard to the effect that inordinate delays occur in the publication of papers by the ASCE. During the war years many special conditions beyond the Society's control did at times cause delays, which were undoubtedly irritating to authors. But the Committee on Publications recognized the obligation for presenting the papers promptly, from the dual standpoints of cooperation with authors and the desirability of giving new technical material to the profession as early as possible. Attack on the problem was directed toward limiting the acceptance of papers, requiring condensation of those accepted, and enlarging the supply of paper stock. The Publications Committee is happy to report the success of all these expedients to the point that normalcy has now been attained.

In the best interest of the profession the procedure of reviewing technical papers must be deliberate. The nature of the subject matter does not encourage snap judgments. Studies by disinterested specialists are essential and these require time. Thus the normal progress of a paper, even when it eventuates in acceptance by the committee, is moderately time-consuming. And after a paper has been approved for publication, further time is required for careful editing, preparation of drawings, and arrangements for a diversification of topics in each issue. These steps require a minimum of six months if everything clicks; and tardiness by one of the invited reviewers, or lack of concurrence, which necessitates sending the paper to one or more additional reviewers, may extend this time by several months.

The committee has received excellent cooperation from authors, reviewers, officers of the Technical Divisions, and the staff in a sustained effort to minimize the normal time-interval between receipt of papers and their publication. Several papers scheduled to appear in PROCEEDINGS before the end of this year were received after January 1; for these the interval between formal submission and actual printing will be less than a year. At the same time, an excellent flow of new manuscripts is coming in, and a satisfactory back-log of material is being maintained to permit efficient functioning by the staff.

What does this "current basis of publication" imply? Simply that any manuscript submitted, or any paper accepted, has the prospect of early use. The Committee on Publications welcomes the opportunity of considering meritorious papers. Authors can submit manuscripts with confidence of prompt handling.

HARRY F. THOMSON, *Chairman*
Committee on Publications

G.I. Student Receives Milo S. Ketchum Award

A VETERAN OF four years' service in the Army Corps of Engineers, Harry A. Weber, is the recipient of the 14th Milo S. Ketchum Award. Mr. Weber, now a student at the University of Colorado, received the prize at the annual Ketchum Award Dinner, held in Boulder, Colo., on May 22.

The award, which is given each year in memory of the late Milo S. Ketchum, was established by former engineering students of Dean Ketchum, who died in 1934. Administered by the Colorado Section, the award consists of the payment of the recipient's initiation fee as a Junior in the Society.

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

SUMMER CONVENTION
Duluth, Minn., July 16–18
(Board of Direction meets July 14–15)
FALL MEETING
Jacksonville, Fla., October 15–17
(Board of Direction meets October 13–14)
ANNUAL MEETING
New York, N.Y., January 21–23
(Board of Direction meets January 19–20)

Coming Events

Florida—Meeting at the Seminole Hotel, Jacksonville, July 10, at 7 p.m. Topic of discussion will be what legislative action should be taken to limit the use of light-gage steel sections for major construction.

Sacramento—Regular luncheon meetings at the Elks Club every Tuesday at 12 noon.

Texas—Joint meeting of the Fort Worth Branch and the Texas Society of Professional Engineers at the Blackstone Hotel, Fort Worth, July 14, at 12:15 p.m. V. M. Ehlers, of the State Department of Health, will speak on "Public Health in Texas."

Recent Activities

ARIZONA

IN A SYMPOSIUM on "The Society and Education" that featured the all-day spring meeting, held in Tucson on May 10, Sigmund Levin, member of the University of Arizona Student Chapter, described ways of making the Society interesting and helpful to the Student Chapter membership and engineering students in general. Discussion of the subject was led by J. S. Gatewood and E. S. Borgquist, professor of civil engineering at the University of Arizona. Talks by two other student speakers — Irwin Shull and John B. Watson — were also scheduled for the technical sessions. Alex Makarov, engineer at Tucson for the Mountain States Telephone Co., addressed the noon luncheon meeting on recent developments in telephony, and reviewed the opportunities in the telephone field for the graduating engineer.

CLEVELAND

ACCOMPLISHMENTS OF THE Cleveland Regional Geodetic Survey, which was begun in 1937, were outlined by Prof. G. Brooks Earnest, consulting director to the Survey, at a recent meeting. The speaker stated that final elevations on all monuments are complete, and that the control is now being pushed to completion. Specifications set forth in ASCE Manual No. 10 were used throughout the survey.

COLORADO

METHODS OF PROTECTING electric power lines against lightning were described by Frank Easton, professor of electrical engineering at the University of Colorado, at the May 12 dinner meeting. Some strokes of lightning contain as high as 150 million volts, Professor Easton stated. Speaking on the proposed amendments to the constitution at the same meeting, ASCE Western Representative Walter E.

Jessup pointed out that the Society has grown beyond its present means of support and emphasized the necessity of obtaining more funds if the ASCE is to go forward with the times and also maintain its present technical interests. Initiation fees for Junior membership in the Society were presented to Carl B. Hayward, member of the University of Colorado Student Chapter, for a paper on "Material and Labor Problems as They Affect Design Today."

CONNECTICUT

A TALK ON Connecticut highways of the future featured a recent dinner meeting. This was given by State Highway Commissioner William J. Cox, who has announced that he will retire as commissioner. An enthusiastic general discussion followed Mr. Cox's talk.

INDIANA

PROGRESS MADE TO date in planning the Detroit-Chicago Expressway was outlined by Samuel C. Hadden, consulting engineer for the Automobile Club of Michigan and the Chicago Motor Club, at a recent joint dinner meeting with the University of Notre Dame Student Chapter. The paramount problem encountered in the planning has been detouring the Chicago and Detroit traffic, according to Mr. Hadden. The new expressway, it was explained, was made possible by the federal-aid Highway Act of 1944, which provides for an ultimate 40,000 miles of interstate highway. The rest of the technical program consisted of a talk on the Canol Project by Carl C. Wilcox, chief engineer on the project and now head of the mechanical engineering department at Notre Dame.

KANSAS CITY

AUTOMATIC DEVICES NOW make it possible to record the reactions of the driving public to various highway conditions without the public's being aware of the fact that it is observed, H. E. Hilts, deputy commissioner of the Public Roads Administration, told members of the Section at a recent meeting. Speaking on engineering problems involved in building safe highways, Mr. Hilts stated that by means of these devices, data on the efficient width of lanes, minimum sight-distance requirements, and other factors have been collected. From these findings, the speaker said, the importance of the horizontal curvature factor and of standardization of highway signs and directions cannot be too strongly emphasized. Much of the research work on safety cited is being done by the PRA and allied agencies, according to Mr. Hilts.

KANSAS

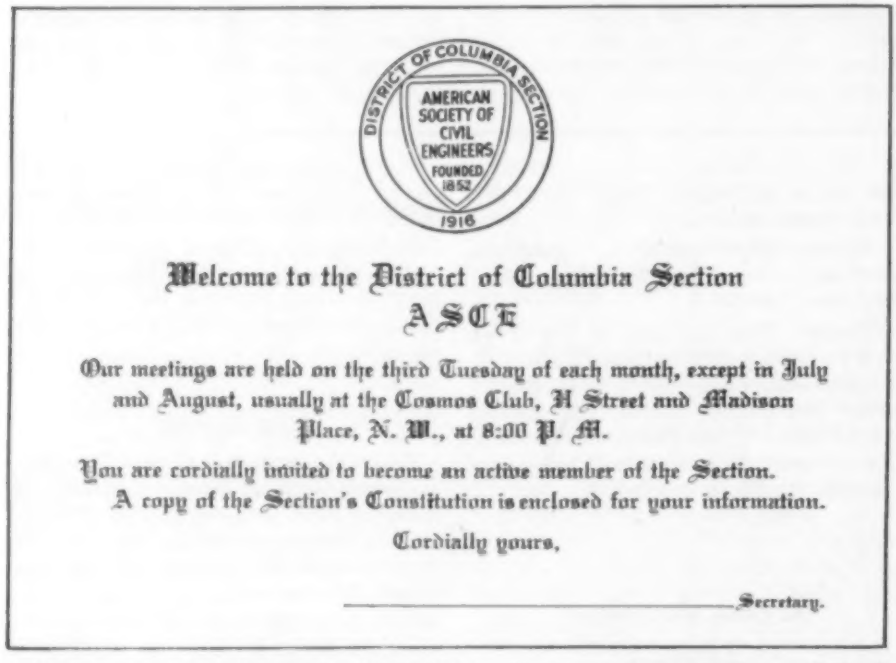
PROBLEMS OF SILTATION in reservoirs and of erosion below large storage dams, as presented at the ASCE Spring Meeting in Phoenix, were reviewed at the May meeting of the Kansas Section by George S. Knapp, chief engineer of the Kansas Division of Water Resources. Mr. Knapp illustrated his talk with slides that he had made on the trip to Phoenix. During the evening, the Section's annual awards of Junior membership in the Society were presented to Edgar B. Johnson, of Kansas State College, and Hugh C. Kershner, Jr., of the University of Kansas.

KENTUCKY

COMPETITIVE SPEECHES BY Student Chapter members featured the May meeting of the Section, which was held jointly with the Student Chapters of the University of Kentucky and the University of Louisville. The first prize of $15 went to W. J. Hollis, University of Louisville, for a talk entitled "Our Teachers Need Help." T. C. Graham, University of Louisville, won the $10 second prize, and J. H. Clark, University of Kentucky, received the third prize of $5. ASCE Junior memberships for the outstanding seniors at the two universities went to Mr. Hollis, and to Clyde Brooks Hill, University of Kentucky.

LOUISIANA

VARIOUS AGENCIES ARE seeking an easy method of field testing the amount of air in concrete, Charles E. Wuerpel, chief of the concrete research division of the U.S. Waterways Experiment Station at Vicksburg, Miss., told members of the Louisiana Section at their May meeting. Mr. Wuerpel described results obtained on jobs constructed under direction of the Corps of Engineers, and pointed out that the present air-entrainment mixture dates back only a few years to the accidental discovery that fats and fish stearates used in grinding cement clinker gave the finished product the faculty of resisting surface spalling in cold climates. He was followed by Walter Carey, of the New Orleans Engineer District, who made the point that research should be conducted on any type of concrete aggregate to avoid the excessive cost of special graded and washed materials. The Section announces that it is now receiving appli-


DISTRICT OF COLUMBIA SECTION
AMERICAN SOCIETY OF CIVIL ENGINEERS
FOUNDED 1852
1916
Welcome to the District of Columbia Section
ASCE
Our meetings are held on the third Tuesday of each month, except in July and August, usually at the Cosmos Club, H Street and Madison Place, N. W., at 8:00 P. M.
You are cordially invited to become an active member of the Section.
A copy of the Section's Constitution is enclosed for your information.
Cordially yours,
Secretary.

DISTRICT OF COLUMBIA SECTION, Washington, D. C., greets new members with "welcome card," shown above.

DISTRICT OF COLUMBIA

WARTIME DESTRUCTION OF Philippine ports was so complete that it is difficult to determine what facilities were available before the war and their adequacy, according to Col. C. L. Hall, of the Army Corps of Engineers. Speaking on reconstruction of the ports at the May meeting Colonel Hall stated that the work of reconstruction has also been hampered by lack of previous records, poor communications, and uncertainty as to what demands on insular ports will be made by the operation of our postwar Pacific bases. Most of the port survey work has been done by plane, the speaker said. Section meetings are now featuring Junior participation in programs. Following a new practice, the Juniors had their own dinner meeting and then attended the May meeting in a group. One of their number, Richard E. Arthaud, was called upon for a ten-minute talk on Society affairs.

cations for its annual scholarships—$125 to a student at the Tulane University civil engineering school, and $40 to a civil engineering student at Louisiana State University.

LOS ANGELES

WARTIME FAILURE OF the Remagen Bridge over the Rhine was analyzed by Lt. Col. C. A. Rust at the May meeting of the Los Angeles Section, which took place at the California Institute of Technology on May 14. Other speakers were Dr. Warren O. Wagner, project supervisor of the Guam Harbor model study, whose talk dealt with construction and operation of a harbor model, and Lee A. DuBridge, president of the California Institute of Technology, who discussed the plans and future of the Institute. Laboratories open for inspection included the astrophysical laboratory, where the 200-in. Palomar mirror is being built. The first annual dinner meeting of the Junior Forum, held on May 21, featured talks by Stanley Goldhaber, Carl Johnson, and Max Strauss, all Juniors.

METROPOLITAN

WORKING SPACE FOR 5,000 United Nations employees and up to 70 member delegations will be provided in the UN's proposed world capital on the East Side of New York, according to Col. Max Abramovitz, partner in the architectural firm of Harrison & Abramovitz and deputy director of planning, UN headquarters. Before an audience of 350 at the Section's annual meeting, Colonel Abramovitz described the designs for three skyscrapers, a low flat Council Chamber building, and improvements to traffic facilities near the site. Harry O. Locher was elected president of the Section for the coming year, succeeding D. B. Steinman. Other officers chosen were Roger W. Armstrong and Morris Goodkind, vice-presidents; Alfred Hedefine, secretary; and Charles C. Trout, treasurer. Robert Ridgway Student Chapter Prizes were awarded by the Section's Committee on Student Chapters to the following outstanding civil engineering seniors in metropolitan engineering schools: Louis J. Capazzoli, Jr., New York University; Edward B. De Leo, Manhattan College; Frank Delvers, Cooper Union; Robert N. Dentz, Columbia University; Reuben H. Karol, Rutgers University; Stanley Lenox, Newark College of Engineering; Nathaniel E. Schwartz, College of the City of New York; and Matthew Stewart, Polytechnic Institute of Brooklyn. Mrs. Robert Ridgway attended the meeting to witness the award of the certificates.

MID-SOUTH

"ENGINEERS, AS A whole, have been delinquent in advancing the profession in public understanding," ASCE Vice-President Ralph B. Wiley told the members of the Mid-South Section at their spring meeting, which was held in Little Rock, Ark., on May 23. In a talk on "The Social Responsibilities of the Engineer" before the evening banquet, culminating feature of the all-day session, Professor Wiley stressed the fact that the engineer is under an obligation to inform himself on the political, economic, and social trends of our times and take his part in the solution of our common problems. Other scheduled speakers were ASCE Director Harry F. Thomson, who addressed the noon luncheon meeting on "The Significance of the Construction Industry," and W. M. Shepherd, director of industrial and rural development for the Arkansas Power & Light Co., who spoke on problems involved in locating manufacturing plants in the South. The afternoon was given over to discussion of the two proposed amendments to the constitution, led by Professor Wiley and Mr. Thomson.

OPERATIONS OF DREDGE "TAYLOR" are viewed by members of Ithaca and Syracuse Sections. Left to right: L. L. Huttleston, president of Ithaca Section; Capt. Angas McLennan; E. Stearns, president of Syracuse Section; and ASCE Director Harland C. Woods.

ITHACA

LOADING AND DUMPING operations of the Army Corps of Engineers Dredge "Taylor" were viewed by members of the Ithaca and Syracuse Sections on a recent joint inspection trip, held in Oswego, N.Y. Two trips were made, while the dredge loaded up in the harbor with silt that causes shoaling and took it to the dumping grounds in Lake Ontario. The "Taylor," a sea-going, diesel-driven hopper dredge of 1,015-cu yd capacity, carries a crew of 42 men and officers. At the May meeting of the Ithaca Section, L. K. Sillcox, first vice-president of the New York Air Brake Co., spoke on future needs in railroad transportation. Award of Junior membership in the Society to Thomas M. Berry, of Cornell University, was announced.

NASHVILLE

A DESCRIPTION OF the proposed sewage collection system and disposal plant for Nashville comprised the technical program at the June 5 meeting of the Section. This was given by Wales Wallace, of the Birmingham, Ala., firm of Polk, Powell & Hendon, who stated that the project will involve several unusual construction features.

PANAMA

THE PROPOSED Curundu culvert is one of the largest single construction projects to be authorized for the Canal Zone since the end of the war, Col. McDonald D. Weinert, district engineer for the Army Corps of Engineers, said in a talk at the May meeting of the Panama Section. The project will carry the Curundu River across Albrook Field to Balboa Harbor. At another recent meeting, ASCE Vice-President Gail A. Hathaway summarized recent technical and professional activities of the Society and stated that an increase in dues will be necessary for continuance of these activities.

PITTSBURGH

GUESTS OF HONOR and principal speakers at the May dinner meeting were ASCE Director William R. Glidden and Executive Secretary William N. Carey. Both Society officers discussed the proposed amendments to the constitution and led a round-table discussion of Society affairs. Section awards of Junior membership in the ASCE were made to Robert E. Graysay, of the University of Pittsburgh, and James F. Baer, of Carnegie Institute of Technology

SPOKANE

PEACETIME FUNCTIONS AND present activities of the Army Corps of Engineers were described by Col. Theron D. Weaver, division engineer for the Army Corps of Engineers at Portland, Ore., at a special technical meeting held in Moscow, Idaho. J. E. Buchanan, president of the University of Idaho, also addressed the dinner meeting, which was sponsored by the Student Chapter at the University of Idaho.

SACRAMENTO

SPEAKING ON "Photoelasticity as Applied to Structural Design" at a recent luncheon meeting, S. N. Cottrell showed that by means of photoelasticity it is possible to find points of contraflexure and thus solve certain statically indeterminate frames. At another meeting, members of the Section heard a first-hand account of the atomic bomb tests at

Bikini, given by the chief electrical engineer for the San Francisco Naval Shipyard. Progress being made in forecasting runoff from snow was described at a third meeting by Walter J. Parsons, chief of the hydrology section of the Sacramento District of the Army Corps of Engineers, in a talk on "Cooperative Snow Investigations at Soda Springs."

ST. LOUIS

PRESENT ACTIVITIES OF the Society, particularly those directed toward the professional development and betterment of the engineer, were stressed by ASCE Director Harry F. Thomson in a talk on Society affairs at the May luncheon meeting. He gave numerous examples of the Society's initiative and activity in national affairs and in national legislation affecting the engineer, and emphasized the fact that drastic curtailment of these vital activities will be necessary if increased funds are not forthcoming. A Junior membership in the ASCE was presented to Harry R. Dreiling as the outstanding civil engineering senior at Washington University. A similar award had already been made in Columbia to Carl Jackson Hunt, of the University of Missouri.

SAN DIEGO

BOTH FRESH AND salt waters have filled the Salton Sea in southern California during its 80-million-year history, Baylor Brooks, professor of geology at San Diego State College, told members of the San Diego Section at their May meeting. The sea, which now has a higher salinity than the ocean, is not a remnant of ocean water, as is often thought, but a fault caused by a downdrop between up-rising ground. Forty feet deep at its lowest point, Salton Sea is 243 ft below sea level and in its present form dates from the flooding of the Colorado and Gila Rivers in 1906 and 1907.

TACOMA

PROGRESS MADE TO date on the Columbia River Basin Irrigation Project was outlined by H. A. Parker, supervising engineer for the U.S. Bureau of Reclamation, at a recent dinner meeting. His talk was supplemented by slides showing construction problems to be solved. At another recent meeting Harold T. Fretz, director of training and research, industrial relations department, Rayonier, Inc., Olympia, Wash., gave the group a better understanding of the pulp process with a talk on the "Manufacture of Dissolving Pulps for Chemical Industries."

TENNESSEE VALLEY

ASCE VICE-PRESIDENT Gail Hathaway attended a recent special meeting of the Knoxville Sub-Section and discussed current activities of the Board of Direction on such questions as labor relations, engineers' salaries, pending congressional legislation affecting engineers, membership dues, and the proposed change to expedite election of new members. A forum discussion on a proposed Architects' and Engineers' Joint Council of Knoxville comprised the program at another meeting. Roy Alspaugh and Harry Tour explained the character and objectives of the proposed organization. ASCE members on the committee that has been drawing up plans for the organization include N. W. Dougherty, A. T. Granger, and W. H. Moehlman.

The history and activities of the Chattanooga Electric Power Board were described by States R. Finley at the May 13 dinner and smoker of the Chattanooga Sub-Section.

At the May meeting of the Oak Ridge Sub-Section, colored movies showing erection of a permanent Bailey Bridge at the Clinton Engineer Works supplemented a discussion of preliminary investigations and erection features of the bridge by David J. Brumley, engineer in charge of the work. Of special interest to Oak Ridge Sub-Section members, because of their contribution to atomic energy work, was the showing of "Operation Crossroads," Navy movie of the Bikini tests.

TOLEDO

NEW TOOLS, PROCESSES, and materials used in the electrical industry were described by F. A. Furfari, of the Westinghouse Electric Corp., at a recent joint meeting with the University of Toledo Student Chapter. On the same program W. V. Gordon, also of Westinghouse, showed a sound film entitled "Adventures in Research."

TEXAS

GAS CAN BE transported to the Atlantic Seaboard by means of the Big and Little Inch Pipe Lines at a cost of about 20 cents per 1,000 cu ft, George R. Brown, Houston consultant, told members of the Texas Section at their annual spring meeting. At another session, D. C. Greer, state highway engineer, reported near completion of programs to connect Texas cities with paved highways. To date, he said, leading Texas cities have let large contracts in an effort to improve local handling of traffic by means of controlled access pavements. Other speakers at the three-day meeting, whose total registration of 402 made it one of the best attended in the Section's history, included S. W. Oberg, chief civil engineer of the Humble Oil and Refining Co., and Col. Henry Hutchings, Jr., division engineer of the Southwest Division of the U.S. Engineer Office. During the business meeting, certificates of life membership were awarded to 12 members, and ASCE Director Oscar Koch discussed the financial condition of the Society and the reason for the proposed constitutional amendments. The varied group activities offered delegates included a barbecue, dinner dance, and tour of the Sheffield Steel Corp. plant.

TRI-CITY

PROBLEMS CONNECTED WITH the construction of the 30-million-dollar Alcoa Project at Bettendorf, Iowa, were outlined by Edward F. Maziarz, chief engineer on the project, at the May meeting of the Section in Davenport, Iowa. Among the major engineering items involved in the work are relocation of existing railroad facilities, enlarging the Riverside Power Plant of the Iowa–Illinois Gas and Electric Co., to handle the load of the new project, and development of a deep-well water-supply system. At another recent meeting, former ASCE Director Wilbur M. Wilson, research professor of structural engineering at the University of Illinois, discussed his experiences as the Society's official representative at the Bikini atomic bomb tests last summer.

VIRGINIA

THE ENGINEER'S ECONOMIC status is very poor, according to S. H. Mehaffey, engineer and director of the Virginia Road Builders Association. Addressing the spring meeting of the Section — held in Norfolk on May 16 in conjunction with local groups of the other engineering societies and the Engineering Club of Hampton Roads — Mr. Mehaffey advocated direct bargaining between employer and employee engineers rather than unions. Legislation to strengthen the engineer's position was proposed by P. A. Rice, first vice-president of the Section. Speaking on the activities of Engineers Joint Council at the local level, Mr. Rice also suggested education of employers as a means of raising engineering salaries and advocated group action by engineers in civic and government affairs to make the public aware of their problems. A technical paper on the abatement of stream pollution in Virginia was read by George H. Buck, consulting engineer of New York and Norfolk.

WISCONSIN

MODEL TESTS MADE by the University of Wisconsin Hydraulics Laboratory were described to Wisconsin Section members at a recent meeting by Arno Lenz, of the Laboratory staff. Mr. Lenz' illustrated lecture dealt with spillway and apron studies of three dams in Wisconsin and with the model tests made for the Carnegie–Illinois Steel Co., at Gary Ind. The main problem in the latter project was to devise a gate that could be built at the outer end of the steel pier slips to reduce the pitch and sway of docked ore vessels while unloading.

STUDENT CHAPTER *Notes*

ALAMEDA FABRICATING WORKS OF BETHLEHEM PACIFIC Coast Steel Corp. are visited by 35 students from University of California Student Chapter, with I. F. Kurz, manager, acting as guide. Visiting group is headed by Clement T. Wiskocil, professor of civil engineering, and R. M. Duncan, Chapter treasurer.

BROOKLYN POLYTECHNIC INSTITUTE

A TWO-DAY INSPECTION trip in upstate New York gave Brooklyn Polytechnic Institute Chapter members a picture of the extensiveness of New York City's water supply system. Dams visited were Ashokan, west of Kingston, and Merriman Dam at Lackawack, now under construction. In connection with the latter, another impounding reservoir is being built at Neversink in the Delaware watershed. The itinerary also included visits to the Universal Atlas Cement plant at Hudson; a stream gaging station of the U.S. Geological Survey; the Hedelberg Filter Plant, which treats the water supply for Albany and the vicinity; and the Rip Van Winkle Bridge across the Hudson at Albany. The trip was arranged by Dr. C. A. Wright, professor of hydraulic and sanitary engineer at the Institute, with the aid of Matthew Stewart, president of the Student Chapter, and John Calamari, Chapter member.

JOHNS HOPKINS UNIVERSITY

JOHNS HOPKINS UNIVERSITY had its first student engineering publication this spring, when members of the Student Chapter there began periodical issuance of the "Gay Civil." The new Chapter news organ, a mimeographed publication also containing editorials, informative articles, and humor, was enthusiastically received by both students and faculty, according to Norman H. Moore, Faculty Adviser. Mr. Moore credits it with doing much to arouse interest and aid in the reactivation of the Chapter after the lull of the war years.

FIRST ISSUE OF "GAY CIVIL," Johns Hopkins University Student Chapter Publication, is presented to President Ted Andriotis, left, by Editor-in-Chief Walt Lyon. Staff members are (left to right) Steve Collins, Circulation; Bill Rasch, Circulation; Mr. Andriotis, News Editor; Gil Levin, Feature Editor; Ruth Ann Murphy, Secretary; Warren Dederick, Art Editor; Joe Prosser, Technical Editor; and Mr. Lyon.

MEMBERS OF UNIVERSITY OF SANTA CLARA Student Chapter tour South San Francisco Steel Plant of Bethlehem Pacific Coast Steel Corp. Building above, now nearing completion, will house most modern laboratory in country for making spectrographic analyses of steel.

NEWS BRIEFS

ABOUT ENGINEERS AND ENGINEERING

Contractors Offer Program to Stabilize Building Costs

STEPS TO HELP STABILIZE construction costs were recommended by the Governing and Advisory Boards of the Associated General Contractors of America at their spring meeting in Seattle. "The public should not be led to believe that there will be quick or drastic reductions in construction costs," the boards asserted in a statement adopted at conclusion of the meeting.

The program recommended to general contractors throughout the country includes:

"*a.* Where it is the normal custom of the contractor, and to the fullest extent possible, firm prices should be quoted to the owner. Contractors should require firm prices from subcontractors, and sellers of materials and machinery.

"*b.* Fair and just wages should be paid to workmen, and all possible steps should be taken to encourage workmen to produce a day's work for a day's pay, to maintain wage rates for agreed upon periods of time, to settle disputes without stoppage of work, to eliminate wasteful practices, and to permit the training of adequate numbers of apprentices to supply additional skilled craftsmen for the industry.

"*c.* All possible steps should be taken to improve efficiency of management.

"*d.* Where possible, owners should be discouraged from demanding the completion of projects at speeds which require overtime work at premium rates of pay, or procedures requiring extra costs."

The boards also called upon all organizations and individuals in the industry to cooperate to help eliminate uncertainties and to permit operations to be carried on as quickly, efficiently and economically as possible.

Long-range planning of public works construction was supported in another statement adopted by the boards. They recommended to Congress that "appropriations be made on a continuing basis to permit advance planning and orderly, economical construction of highway, flood control, river and harbor, reclamation, soil conservation, rural electrification, and other similar public works, and that all such work be executed by contract, with the contracts awarded to the lowest responsible bidder after due advertisement."

Under a long-range planned program "both government departments and contractors can organize to carry out the planned work efficiently. Such orderly development will tend to minimize inflation and depression periods," the boards said.

Fifteen-Year Housing Needs Are 85–87 Billion Dollars

CAPITAL EXPENDITURES of roughly 85 to 87 billion dollars would be required by a fifteen-year program to fill America's housing needs, according to a new Twentieth Century Fund survey titled "America's Needs and Resources." These costs were figured in 1940 prices, making them conservative in terms of the present level.

This total represents an average expenditure of 5.7 or 5.8 billion dollar annually to build nearly 19.7 million new houses and rehabilitate 5.4 million units at the rate of 1.3 million new houses and 363 thousand rehabilitated units a year. A careful study of house building in the past forms the basis for these estimates.

Despite the unsatisfactory condition of more than half our houses, the fund estimates actual demand at no more than 84 to 86 percent of the need, or around 72–73 billion dollars for both new and rehabilitated houses at an annual expenditure of 4.1 billion dollars for 16 million new houses—at slightly over a million units a year.

This demand figure is based on the assumption of high-level employment and a high national income, conditions that would make it possible for normal market operations to supply the bulk of our housing requirements.

"The importance of capital outlays for housing can hardly be exaggerated," Evans Clark, executive director of the Twentieth Century Fund, said. "Upon their size depends the quantity and quality of our houses. Moreover, they constitute in normal times one-fifth of all capital expenditures. This means that housing is one of the major outlets for investment and therefore vitally important for maintaining high employment and production."

In the survey urban costs were estimated at $3,500 per unit for minimum standard new construction or replacement and $1,000 for rehabilitation. Rural non-farm costs were figured at $2,500 per unit for new construction and $700 for rehabilitation; farm costs at $1,500 for construction and $400 for rehabilitation.

Uniform Law Enforcement Asked for Highway Safety

TRAFFIC LAWS and regulations must be enforced rigidly and impartially if our highways are to be safe, Maj. Gen. Philip B. Fleming, M. ASCE, Federal Works Administrator and general chairman of the President's Conference on Highway Safety, told the Tennessee Press Association at Memphis, Tenn., recently.

Calling for uniform enforcement without special privilege, he said, "The press owes a responsibility to its readers to report fully and accurately the manner in which that job is done. . . . Accurate, thoroughgoing reporting will very quickly reveal what policemen and what courts are conscientiously trying to protect human life, and if correction is needed, the people can be depended upon to apply it at the next election."

General Fleming also urged uniformity in traffic regulations and in street and highway warning and directional signs. "I firmly believe," he said, "that a roadside sign of a certain size and shape should say and mean the same thing in every state in the Union, but certainly there is little excuse for a confusing diversity of signs throughout the towns and counties of a single state."

He termed public indifference the real but intangible enemy of efforts to promote safety, but expressed the belief that fearless, objective reporting of accidents and violations can overcome the feeling that "the reckless driver, the careless pedestrian, is always the other fellow." After the action program adopted by the conference last year had been put into effect in city after city, the fatality curve turned sharply downward, he reported. By the end of last December 6,000 persons were still alive who would have died if the high fatality rates of the first six months of 1946 had continued.

Million New Dwelling Units Slated for 1947 Completion

AT LEAST A MILLION dwelling units, three-fourths of them permanent homes, will be completed this year if federal controls are continued for a few months, Housing Expediter Frank R. Creedon said in a recent report. This will be the best year on housing completions since the middle twenties, he declared.

On the basis of new homes already completed this year, those now under construction and those expected to be under construction by August 15, Mr. Creedon estimated that at least 750,000 new permanent homes would be built this year. Last year, which he described as a good building year, only 454,000 new permanent homes were completed. The present total of

196,000 completed temporary units will swell to 278,000 by January 1, Mr. Creedon predicted.

"I must emphasize, however, that such a record home-building achievement will be possible only if controls on non-residential construction are continued a few months longer," he warned. "Right now there is a backlog of more than $2,000,000,000 in deferrable non-residential projects being held up because of material shortages. If this pent-up demand were suddenly turned loose on the building materials market, the resulting scramble for materials would leave the little fellow trying to build a home out in the cold both literally and figuratively."

Large Earthfill Projects Announced by Bureau of Reclamation

UNDER THE HEADING of "Prospective June Bid Calls," the Bureau of Reclamation's *Advance Construction Bulletin* announces several huge earthwork jobs in Western states. According to the bulletin, all information published is subject to revision, but the data will serve as a guide to the nature, size and locations of the proposed reclamation projects.

CANAL

North Unit Main Canal, Deschutes Project

Location: North central Oregon, near Madras.

Work: Construction of earthwork and structures for North Unit Main Canal, sta. 3,010 + 50 (Willow Creek siphon) to sta. 3,562 + 30.

Excavation, canal	196,000 cu yd
Excavation, structures	12,000 cu yd
Furnishing and placing reinforcement steel	150,000 lb
Installing gates and misc. metal work	25,500 lb
Concrete	1,600 cu yd

Time Allowed for Completion: 230 days.

EARTHFILL DAM—POWER PLANT—RAILROAD RELOCATION

Boysen Dam, Missouri Basin Project

Location: North central Wyoming, 15 miles south of Thermopolis.

Work: Construction of earthfill dam, concrete power plant, and appurtenant works; relocation of C. B. & Q. Railroad.

DAM AND APPURTENANT WORKS

Excavation, borrow	1,150,000 cu yd
Excavation, structures	1,000,000 cu yd
Embankment	1,500,000 cu yd
Concrete	50,000 cu yd
Reinforcement steel	4,700,000 lb

RAILROAD RELOCATION

Excavation, roadway	2,000,000 cu yd
Excavation, structures	40,000 cu yd
Excavation, tunnel	140,000 cu yd
Concrete, tunnel	50,000 cu yd
Railroad track	13 miles

Time Allowed for Completion: 1,400 days.

LATERALS

North Unit Laterals, Deschutes Project

Location: North central Oregon, near Madras.

Work: Construction of earthwork and structures for laterals and sublaterals, North Unit Main Canal, sta. 3010 + 50 to sta. 3562 + 30.

Excavation, laterals	225,000 cu yd
Excavation, structures	11,000 cu yd
Reinforcement steel	100,000 lb
Installing gates and misc. metalwork	35,000 lb
Concrete	1,150 cu yd
Laying concrete pipe	4,000 ft

Time Allowed for Completion: About 200 days.

LATERALS—STRUCTURES—PIPELINES

Roza Division, Yakima Project

Location: South central Washington, near Sunnyside.

Work: Construction of earthwork and structures for lateral system. Excavating for pipeline. Furnishing and installing 6-in. to 18-in.-dia standard concrete irrigation pipe.

Excavation, laterals	21,000 cu yd
Excavation, pipe trenches	9,000 cu yd
Furnishing and installing concrete irrigation pipe	37,500 ft

Time Allowed for Completion: 210 days.

TRANSMISSION LINE

Parker Dam to Pilot Knob Line, Davis Dam Project

Location: San Bernardino, Riverside, and Imperial Counties, California.

Work: Construction of 123 miles of 161-kv transmission line, with overhead ground wire, from Parker Dam to Blythe thence to Pilot Knob; wood poles, H-frame type.

Time Allowed for Completion: 300 days Parker to Blythe; 450 days Blythe to Pilot Knob.

PUMPING PLANT—SIPHONS

Jordan Narrows Pumping Plant, Provo River Project

Location: North central Utah, 6 miles northwest of Lehi.

Work: Construction of pumping plant, steel pipe siphons, and appurtenant structures.

Excavation	35,000 cu yd
Backfill	15,000 cu yd
Concrete	3,800 cu yd
Reinforcement steel	500,000 lb
Installing pumps	51,000 lb
Installing penstocks	690,000 lb
Installing misc. equipment	40,000 lb

Time Allowed for Completion: About 270 days.

CANAL

Wyoming Canal Extension, Riverton Project

Location: West central Wyoming, 15 miles northwest of Riverton.

Work: Construction of earthwork and structures, sta. 883 to sta. 1606.

Excavation, canal	2,000,000 cu yd
Excavation, structures	70,000 cu yd
Concrete, structures	3,000 cu yd
Reinforcement steel	400,000 lb

Time Allowed for Completion: 540 days.

LATERALS—STRUCTURES

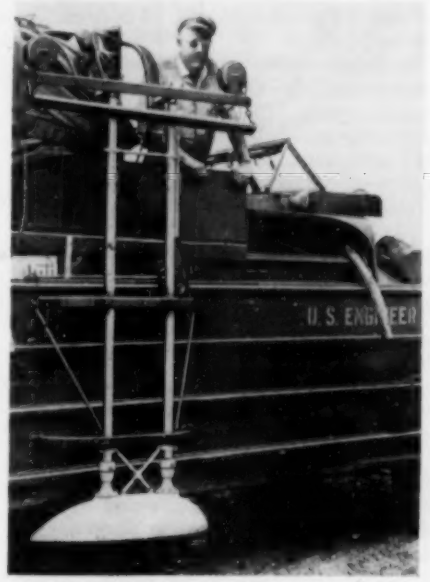
"C"-Line Canal West Laterals, Boise Project

Location: Southwest Idaho, near Caldwell.

Work: Construction of earthwork and structures for "C"-Line Canal West Laterals.

Excavation, laterals	80,000 cu yd
Excavation, structures	10,000 cu yd
Concrete, structures	640 cu yd
Placing reinforcement steel	35,000 lb

Time Allowed for Completion: 180 days.



WAR-BORN DUCK, although no longer manufactured by GMC Truck & Coach, continues to perform many unusual jobs. On Lake Michigan U.S. Engineers use specially equipped 2½-ton amphibious military truck to study beach erosion. Bureau of Ships also uses amphibious vehicle, to chart wave action along Pacific Coast.

Underground Facilities Are Better Protection Against Bombing Than Heavy Concrete Construction

UNDERGROUND FACILITIES ARE considered one of the most effective means for protecting aircraft production against air attacks of the type experienced in World War II, according to officials of Headquarters Air Materiel Command, Wright Field, Dayton, Ohio. Acting for the Army Air Forces, AMC is currently analyzing statistics, reports, and case studies prepared by other services, some specifically for AMC, in an effort to determine the results of German underground industrialization experience. This study of Nazi underground factories is an important part of the AAF program for air industrial preparedness planning.

The Germans had been experimenting with and utilizing underground structures for some time prior to World War II, construction having been started in 1916 on underground storage installations at Baden near Hamburg. Although this type of construction was halted at the end of World War I, it was reinstituted in 1935 as part of German preparations for a revitalized war industry.

The first German underground factory on record was a precision instrument plant installed in caves at Mulhausen, Thuringia, as early as 1917. When all-out air attacks began in 1944, Hitler ordered an organized effort to move aircraft factories underground. But, even before this, after the Allied bombing on Peenemunde in September, 1943, Hitler had ordered his favorite project, the production of V-2 bombs, into an underground site that was later developed into the largest working in the world. However, disrupted conditions under which the Nazis were operating, the lack of time, and the failure to formulate realistic plans in advance prevented the full realization of their underground program.

In actual development of underground construction, the Germans attempted two general types: One, a semi-underground structure, intended to withstand the heaviest known bombing attacks; and the other, a complete underground plant. One of the semi-underground types was the submarine pen, and it was not until the latter part of the war that allied air forces were able to develop bombs of adequate destructive and penetrative force to damage them.

Generally, these sub pens were massive vaults with huge wall and ceiling coverages of heavily reinforced concrete. The one at Hamburg consisted of five sections, each docking four submarines. It was approximately 500 by 475 ft, with a roof ranging in thickness from 11 to 13 ft. By April 1945, bombs had been developed that could penetrate these roofs. On one mission six direct hits pierced the roof of one pen, killing 40 persons and damaging the equipment.

However, a submarine assembly plant located at Farge, near Bremen, erected above ground, had a roof thickness of 14 ft 9 in. As the power of Allied bombs increased the Nazis planned to increase this thickness first to 23 ft and later to 32 ft 9 in. There is scant evidence to determine whether or not a 23-ft slab could withstand the impact of the 22,000-lb bomb, but it is held likely that a 35-ft slab would have afforded adequate protection from any weapons used during World War II.

In addition to submarine pens, the Nazis had a construction called the "bunker plant," a semi-underground structure that allowed manufacturing operations with comparative freedom from bombing attacks. They were great dome-shaped structures, with reinforced concrete convex roofs, 9 to 18 ft thick, about 80 ft high, and comprised four to six stories allowing approximately 1,200,000 sq ft of floor space, 40 percent of which was underground.

The bunker-type construction probably represented the most suitable type of semi-underground installation that was designed by the Germans inasmuch as it combined large areas of free floor space, adequate height, ease of access, together with a certain degree of protective effectiveness. Nevertheless these structures suffered from a general drawback, the fear that a new type of bomb would be devised to penetrate the concrete shell.

Public Apathy Blamed for Accidents and Traffic Delays

ENGINEERING SCIENCE HAS the solution to traffic problems, but public apathy has retarded the application of technical skills which could eliminate accidents and traffic delays, Henry K. Evans, Assoc. M. ASCE, director of the traffic engineering division of the National Conservation Bureau, said in a recent speech before The Municipal Engineers of the City of New York. Speaking on the subject, "Getting Results Through Traffic Engineering," Mr. Evans described recent developments in traffic control which have been installed in various cities to cut down traffic congestion and eliminate accidents.

"Whenever engineering's forces of scientific calculation of cause and effect have been brought to bear on accident or traffic problems, the results have been amazing," he said. "It isn't the lack of technical skill which retards the solution of the traffic problem. It is rather the apathetic attitude on the part of the general public whereby safety devices, laws and procedures have to be either forced down their throats or else 'sold' to them through the educational efforts of various organizations."

N.Y. State Offers Aid in Planning Sewage Projects

PLANNING AID FOR SEWER SYSTEMS and sewage treatment projects in New York State is now available under the provisions of a bill recently signed by Governor Dewey, Assemblyman Harold C. Ostertag has pointed out in a letter to all appropriate local officials. Provision for such aid was recommended by the Special Committee on Pollution Abatement of the Joint Legislative Committee on Interstate Cooperation of which Mr. Ostertag is chairman.

Assemblyman Ostertag urged all localities in need of such projects to "undertake planning programs and avail themselves of the financial aid offered by the State of New York to expedite pollution abatement." Hundreds of cities, towns and villages are in need of such systems, he said, basing his statement on studies made in 1946 by the Pollution Abatement Committee. These studies authorized by the legislature will continue, he stated, "to the end that an equitable and effective solution of the state's stream pollution problem may be realized." Planning is the first step in such a program.

Under the terms of the act (now Chapter 578, Laws of 1947), the state will extend aid up to half the cost of plans for sewer and sewage treatment projects, but not to exceed 2 percent of the construction cost of such projects. Applications should be addressed to the Temporary Bureau of Municipal Postwar Planning, Department of Public Works, State Office Building, Albany, N.Y.

Keep Motorists and Trains Apart, Says ARBA Chairman

"KEEPING MOTORISTS AND TRAINS apart is the only way to stop the highway-railroad grade-crossing accident," Robert B. Brooks, M. ASCE, chairman of the American Road Builders' Association committee on railway and highway grade separations, declared in a recent statement.

Mr. Brooks pointed out that more than one-fourth of such collisions are caused by motorists driving full speed into speeding trains or locomotives. "Motorists and trains can be kept apart only through separation of grades and closing abandoned crossings by law," he said.

Major Brooks, a consulting engineer in St. Louis, said that 1,853 persons were killed and 4,399 were injured in highway-railroad grade crossing accidents in 1946. During the past ten years, this type of accident has taken the lives of 17,537 persons and injured another 45,507, a number equal to the population of a good-sized city. The accidents, along with many other types that brought our highway death toll up to 33,500 last year, can be reduced through modern highway design, he added.

Engineers from 34 Countries Study U.S. Highway Methods

OPPORTUNITY TO STUDY U.S. techniques in highway design and construction was extended by the Public Roads Administration to 183 engineers from 34 foreign countries during the past year. The largest number came from Brazil, which sent 11 civilian and 15 army engineers. India sent 22, China 13, and Russia 10.

R. ROBINSON ROWE, M. ASCE

"SOMETIMES a Guest Professor is a convenient goat," said Professor Neare. "For two months I've been pestered by you structural experts of our Engineers Club as to whether I endorsed the slope-deflection, moment area, traverse, or elastic-support method for analysis of pseudophallic frames, and I just answered, 'Wait; Professor L. A. Bridger will have to answer that!'"

"Only if Joe Kerr and Cal Klater flunk," retorted Professor Bridger.

"I flunk unless you give me credit for trying," said Joe, pinning up a drawing.

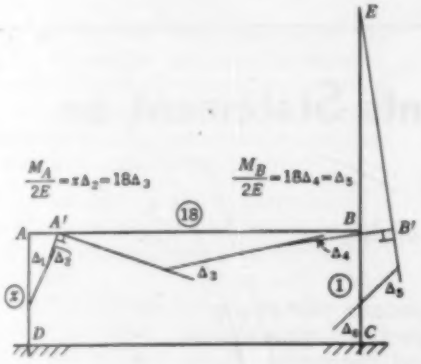


Fig. 1. Joe Kerr's Traverse.

"Using the traverse method, I found these relations between the six deflection angles:

$$\Delta_1 - \Delta_2 - \Delta_3 + \Delta_4 + \Delta_5 - \Delta_6 = 0 \ldots (1)$$
$$2\Delta_1 - \Delta_2 + \Delta_5 - 2\Delta_6 = 0 \ldots (2)$$
$$\Delta_3 - 2\Delta_4 - 3\Delta_5 + 3\Delta_6 = 0 \ldots (3)$$
$$7\Delta_5 - 8\Delta_6 = 0 \ldots (4)$$
$$18\Delta_4 - \Delta_5 = 0 \ldots (5)$$
$$x\Delta_2 - 18\Delta_3 = 0 \ldots (6)$$

"The first is the angle closure, (2) equates horizontal deflections of A and B, (3) equates their vertical deflections, (4) has to be true to hold E in place, and the last two equate moments each side of A and B related to deflection angles by moment areas. So far it was an everyday problem, not a puzzle, but for 7 unknowns I need another equation. Maybe you forgot to dimension AB, or maybe if it had been I building the bridge, the Chief would have kept his daughter home nights."

"Joe did all right except for three mistakes," was Cal's compliment. "The dimension AB wouldn't give him another equation, he has only 6 unknowns, and daughters won't stay home nights. His unknowns are the stiffness x and the ratios of five of the deflections to the sixth, which will be clear if each equation is divided thru by the sixth deflection angle. These five unknown ratios can be eliminated to find $x = 63$. That's so stiff that I wonder you didn't think of putting in a diagonal brace!"

"That 63 is right and the diagonal suggestion is nice engineering but careless herpetology—snakes glide up diagonals with ease. The general solution of the frame is

$$x(3pq - 6q - 4p - 4) = p(6q + 3p + 4)$$

where p is the stiffness of AB and q is the ratio of BE to BC. Combinations in integers are numerous. Anything to add, Noah?"

"Just one thot, L. A. To be consistent, the coefficients of Joe's equations must form a vanishing determinant:

$$0 = \begin{vmatrix} 1 & -1 & -1 & 1 & 1 & -1 \\ 2 & -1 & 0 & 0 & 1 & -2 \\ 0 & 0 & 1 & -2 & -3 & 3 \\ 0 & 0 & 0 & 0 & 7 & -8 \\ 0 & 0 & 0 & 18 & -1 & 0 \\ 0 & x & -18 & 0 & 0 & 0 \end{vmatrix} = -20(x - 63)$$

which gives the answer directly. Now we'll hear from an old friend, Professor Timothy Burr, who does things with a cold deck."

"Not I, Noah, but a card sharp named Amby Dexter. Amby shuffles by cutting a 52-card deck in two equal parts and riffling them together with precise alternations so that the order is restored by 8 shuffles. He gave me part of the deck to practice on and I restored order in 11 shuffles. How many shuffles were needed for the part he kept?"

[*Cal Klaters were Anne Othernut (J. Charles Rathbun), Richard Jenney, R. A. Skinner, Thomas A. Anneus, Stewart Mitchell, and Bill Derr (Coleman W. Jenkins). Guest Professors Bridger and Burr are Ralph Stewart and Charles F. Ruff respectively.*]

Students Win Davis Award Given by Welding Society

WINNERS OF the 1947 A. F. Davis Undergraduate Welding Awards are John W. Price, of Rose Polytechnic Institute, Terre Haute, Ind., $200 first prize, and Howard Sanders, of Cornell University, Ithaca, N.Y., $150 second prize.

"Atomic-Hydrogen Arc Welding" was the subject of Mr. Price's paper, published in the March 1947, issue of the *Rose Technic*. Mr. Sanders' article, "Welders in Diving Suits," appeared in the March 1947, issue of the *Cornell Engineer*. Each of these undergraduate magazines will receive awards of $200 and $150, respectively, for being the publications in which the prize-winning articles were printed. Sponsored by A. F. Davis, vice-president and secretary, Lincoln Electric Co., the award is an annual event of American Welding Society.

Meetings and Conferences

American Water Works Association. Water pollution and purification problems will be discussed at the 67th annual conference of the American Water Works Association, to be held—concurrently with a meeting of the Federation of Sewage Works Associations—in San Francisco, Calif., July 21–25.

Wool Gatherings by WOOLLEY

ALUMINUM PIPE is being used increasingly in portable irrigation systems. A 20-ft section of 4-in. pipe weighs only 19 lb.

A NEW ELECTRONICS INSTRUMENT determines thickness of pipes, storage tanks, pressure vessels, ship hulls, etc., by means of vibrating crystal applied to the surface.

DYNAMITE IS BEING USED successfully in North Dakota to blast reservoirs and drainage ditches on farms.

THE GREATEST USER of electric energy in 1946 was the chemical industry; iron and steel came next then mining, smelting and refining and then paper.

RESEARCH ON GAS TURBINES is well under way in America, England and Switzerland.

NEWS FROM OSLO describes the construction of the world's finest atom bomb-proof factory at an estimated cost of $14,000,000.

TODAY'S FOREST ACCESS ROADS carry trucks with loaded widths up to 14 ft and loads weighing up to 70 tons.

A PERMANENT ORGANIZATION, the International Civil Aviation Organization, has come into being for the promotion of greater world-wide cooperation in the aeronautical field.

THE FEDERAL POWER COMMISSION survey of southeastern Alaska has found 228 feasible power sites in 200 different projects, confined to about 10 percent of the total area. Potential capacity is 789,860 hp of dependable power and 1,008,370 hp of average power.

A MAHOGANY BATH TUB lined with sheet metal is said to have been the first bathtub installed in a U.S. home—in Cincinnati, Ohio, 1842. It was publicly denounced as an undemocratic vanity.

SOME 750,000,000 METEORITES plunge into the atmosphere each day, almost all to be vaporized by rubbing the air.

BOTH THE ARMY AND THE NAVY have adopted the nautical mile as the standard unit of distance for planes and the knot as the standard unit of speed.

KANSAS STATE HIGHWAY COMMISSION has purchased 600 ft of Bailey-type bridge units for emergency use when bridges are washed out.

TEMPERATURE AT THE EARTH'S CENTER is calculated to be 630,000 deg F, and the pressure around 2,500,000 tons per sq in.

GEOPHYSICISTS WHO FORETOLD the dry years that started in 1930 have put the finger on 1954 to 1956 as another critical period.

"IN THE LAST 3,400 years, only 268—less than 1 in 13—have been free from war."
—General MacArthur.

UNIVERSITY OF DETROIT STUDENT CHAPTER is host to other Michigan Student Chapters and University of Toledo Chapter at all-day Student Conference. ASCE Mid-West Representative George S. Salter is shown in center of front row. Story of conference is on page 53.

Membership Grades Committee Presents Statement on Grades Question

Questionnaire to Be Mailed to Membership

TO PERMIT SOCIETY Members to study and discuss questions pertaining to membership grades, an explanatory statement and specimen questionnaire relating to the membership structure are published herewith. Included in the statement are pro and con arguments as developed by the Committee on Membership Grades as well as the committee's recommendations covering each question. The questionnaire contains questions other than those on membership grades the results of which will be of statistical interest and value to the Society. All answers to questions are coded to facilitate analysis. The accompanying statement and questionnaire should be used for study. Another copy of the questionnaire will be mailed later to each member.

Statement

1. A study of the membership grades of the Society with a view to their simplification has been under way since 1944. Before the committee making the initial study had completed its report, President (now Past-President) J. C. Stevens called a conference of representatives of various elements in the Society to consider means for expanding the Society's usefulness through expansion of its membership. That Exploratory Conference met in January 1946. It made recommendations with respect to changes in membership grades and the Committee on Membership Grades was asked to review those recommendations before submitting its report to the Board of Direction.

2. When retiring President Stevens turned the findings of the Exploratory Conference over to the Board of Direction in January 1946, he said:

"There are two concepts of the reasons for the existence of the American Society of Civil Engineers: (1) To honor the top men of the profession, recognizing their attainments by admission to its membership. As long as membership is based entirely on attainments the Society will become static and its size will remain relatively small. In the other concept (2), the accent is on finding means of rendering more service to the whole profession. The Society has hardly scratched the surface of discovering and following through on services that could be rendered either in the technical and research fields or in the professional, economic and social welfare field. We are now at the crossroads for our choice between an outstanding static honor society or an outstanding and growing service society that will bring honor to us as leaders in our profession."

3. The Committee on Membership Grades submitted a report to the Board of Direction at the July 1946 Convention of the Society. The Committee, in its report, outlined several steps it believed necessary in order that the Society might proceed toward the objective outlined as concept numbered (2) quoted above. This objective, that of "expanding the service of the Society to the public and to its members," the Committee reported, "can best be fostered by simplification of the membership structure." In its re-

port, the Committee presented arguments pro and con relating to the several steps it outlined and then made a definite recommendation covering each.

4. The Committee also recommended that a questionnaire be sent to each member of the Society, together with the recommendations of the Committee on the questions to be presented.

5. After reviewing the Committee's reports at the July 1946 meeting, the Board instructed Director Gamble, then chairman of the Committee, and Executive Secretary Carey to:

> "Develop a questionnaire (relating to membership structure), with questions that will not be leading, but with pro and con arguments as developed by the Committee, without recommendation, and that such questionnaire be sent to each member of the Society. It was directed that the questionnaire be coded in so far as practicable to facilitate analysis. Details of the exact method of handling the questionnaire through the Local Sections were left to be worked out by Director Gamble and Secretary Carey."

At the October 1946 meeting of the Board, its earlier instructions were expanded to direct the Executive Secretary to add to the questionnaire on membership structure other questions of statistical interest and value to the Society.

6. Pursuant to these instructions, a questionnaire is presented for the consideration of all members of the Society, in all grades. The questionnaire which follows this statement is a specimen copy for use in study and discussion. It should not be filled out for return. An additional copy will be transmitted later for you to fill out and return. Your questionnaire answer, when returned, is intended to be anonymous.

7. In accordance with instructions by the Board of Direction, pro and con arguments are presented covering membership grades questions. No claim is made that all possible pertinent arguments on them are here shown. The intent is to transmit information sufficient to invoke deliberate consideration of the questionnaire on the part of members.

8. The grade of STUDENT in the Society itself is proposed. Under the Society's present constitution, the members of its Student Chapters have no standing as members of the Society. ASCE has no student grade of member and obtains no dues revenue from students as is the case in some other engineering societies. It is recognized that creation of a student member grade in the Society would place a heavy responsibility on the shoulders of the faculty advisers of Student Chapters in that the initial sifting of men admitted to such a grade would be placed, to a great degree, in the hands of the faculty advisers. Many men doubtless would enter the Society through the STUDENT grade, if created; however, they would not become corporate members of the Society unless later transferred to a higher grade upon application to the Society and election by the Board of Direction. Suggested qualifications for the grade of STUDENT follow:

"Any person registered as a student, graduate or undergraduate, in a university or technical school of recognized standing where a Student Chapter is existent and who is pursuing a regular course in preparation for the profession of engineering."

It is proposed that membership in the grade of STUDENT, if adopted, shall terminate not later than one year after graduation.

9. The Committee on Student Chapters has not taken a definite position on the creation of a grade of STUDENT. Whether the inherent difficulties would outweigh the expected benefits to the students or to the Society is open to question. The Committee on Membership Grades is in agreement that the matter of the creation of a non-corporate grade of STUDENT in the Society should be weighed thoughtfully by the membership at large.

10. A change in the title of the grade of Junior to that of ASSOCIATE MEMBER is proposed. This question has a companion question, that of combining the present Associate Member grade with that of the present grade of Member and of changing the requirements for the new grade of ASSOCIATE MEMBER to those of the present Junior grade. Under these proposed changes, we could have a new non-corporate grade of STUDENT; a new corporate grade of ASSOCIATE MEMBER, which would include all present Juniors; and a new corporate grade of MEMBER, which would include all present Associate Members and Members. The proposed qualifications for the proposed new corporate grade of ASSOCIATE MEMBER are as follows: "An ASSOCIATE MEMBER at the time of his admission shall be a graduate of a school with an accredited engineering curricula, or he shall have been engaged in engineering work of a character satisfactory to the Board for at least four years. He shall be not less than 20 years of age, and his connection with the Society shall cease when he becomes 32 years of age unless he has transferred to a higher grade."

11. According to one school of thought, the present division of grades as between Associate Member and Member has progressively lost its originally intended significance and it would be more appropriate for those qualified for corporate member grade, as presently determined, to be given the single designation MEMBER. If the title of the grade of Junior is to be changed to that of ASSOCIATE MEMBER as proposed, but without change in qualifications of the Junior grade, it is obvious that a change in the title of Associate Member is required. None of these grade and title changes can be considered alone. All are interrelated.

12. Many present members with the title and grade of Junior hold that the designation is a definite liability to them. They hold that such title is not indicative of the fact that they have all the qualifications for the corporate membership as presently prescribed in the Society except, perhaps, the specified experience. They point out that regardless of their experience they are now not eligible to the Associate Member grade until age 27. They also assert that the proposed abandonment of the title "Junior" would eliminate one item of sales resistance by young engineers against promptly becoming members of the Society. Other Juniors state they find no handicap in that title but they feel that Juniors should have some corporate rights: those of voting for the officers of the Society and perhaps holding office at higher than Local Section level. The Committee on Juniors feels that Juniors should be granted at least some of the rights now reserved for corporate members, but it has not indicated otherwise a definite position on the matter. The corporate members of the Society will be balloted after the Summer Convention, 1947, on the question of giving Juniors, as presently classified, full voting rights in the Society.

13. Combination of the present Member and Associate Member grades into a single grade of MEMBER has been proposed. Some of the arguments for and against that proposal follow:

(*a*) From the time of its organization in 1852 until 1891, the Society had but one corporate grade, that of Member. The associate grade was created in 1891. By making the requirements for associate grade the same as those established formerly for Member grade, the Society, without raising its basic requirements for corporate membership, created a higher grade that automatically became a distinction to be sought by men in the lower grades.

(*b*) At that time the distinction between the two grades was not great, being chiefly four years of "responsible charge of work" and four years of active practice. Progressively, however, in the thinking of the Board of Direction, when passing on the qualifications of men ap-

plying for admission to the Member grade, that gap was widened. It was not widened formally in the Society's Constitution until as recently as 1930, when the phrase in the qualifications for Member grade was rewritten to read "responsible charge of *important* work for at least five years."

(*c*) Those who favor retention of the two grades hold that the appellation "Member, American Society of Civil Engineers" has come to be a mark of distinction that should not be lightly put aside. Also, they state that maintenance of a higher grade of corporate membership has a psychological value in stimulating men in the lower grades to seek the qualifications necessary for the upper grades. They hold, also, that it has value in indicating to the public the professional standing of an engineer.

(*d*) Advocates of retention of the two grades note further that, as a practical matter, the associate grade cannot be eliminated without lowering the qualifications for the grade of Member, which they believe would be detrimental to the Society as a whole.

(*e*) Those who favor elimination of the associate grade admit that the present distinction between the two grades may have had some value when it was set up 55 years ago. They contend, however, that it has been losing that value as registration of engineers has spread across the country, until now it is of minor significance. They note further that the present system always has had the major weakness of not providing for automatic advancement of Associate Members to Member grade when those members attain the necessary qualifications. As a result, many modest men or busy men with ample qualifications for the higher grade remain in the lower grade, frequently because they do not wish to trouble themselves, their employers and their associates with filling out the necessary forms that are required for the transfer. More ambitious men, on the other hand, frequently apply for advancement to the higher grade immediately upon being able to make a reasonable showing of qualification.

(*f*) But the strongest objection to the distinction between the two grades, according to those who would eliminate the distinction, is its anomalous relation to the registration laws now on the statute books of every state in the Union. In all of the states, the qualifications that a man must have to practice as an engineer are set forth in law, and if he can demonstrate that he has the specific training and practical experience, he is permitted to practice. He is a professional engineer without qualification except, in a few states, as to the field of engineering in which he practices. Yet the American Society of Civil Engineers, whose members played a major part in getting the registration laws passed, continues to divide its corporate members into "sheep and goats," saying to the public, in effect, these (the Members) are fully qualified engineers, while those (the Associate Members) have such limited qualifications to practice as engineers that we only admit them to a minor grade.

14. A new grade of FELLOW was proposed by the Exploratory Conference. Some of those who favor elimination of the present Associate Member grade believe that there should be a grade superior to the present Member grade to be known as "Fellow" or "Senior Member." Qualifications for such a grade, according to its proponents, should be so restrictive that only engineers of outstanding achievement can qualify. The Committee has suggested that past officers of the Society be qualified automatically to advance to the FELLOW grade if established. Entrance would be either by nomination or application. Qualifications would be approved by the Board of Direction on recommendation of its Membership Qualifications Committee, and be controlled so that membership in the FELLOW grade would not exceed about 10 percent of the membership.

15. The chief justification for a senior grade of FELLOW is that it would provide a top grade to which especially qualified Members might aspire or to which such men might be named in recognition of special service to the Society. Such a grade would lie some place between the present Member grade and that of the present Honorary Member.

16. The disadvantages of the creation of such a "senior" grade are stated by opponents of the plan to be about as follows:

If the higher grade is to be one to which a Member will be advanced on application, then all the inequities and unfortunate characteristics of the present distinction between Member and Associate Member will be retained; if advancement by election is substituted, then committees in every section must give a considerable amount of time to selecting candidates, and there is a possibility of wire pulling by those who seek election to the higher grade while modest individuals hold back.

17. A change in the present requirements for the grade of Affiliate is proposed. The present requirements are as follows:

> "An Affiliate shall be a person who, by scientific requirements or practical experience, has attained a position in his special pursuit qualifying him to cooperate with engineers in the advancement of professional knowledge and practice, but who is not a professional engineer. He shall, at the time of his admission, have had responsible charge of important work for at least five years, and shall have been engaged in his special pursuit for at least twelve years, and shall be not less than thirty-five years of age."

The proposed requirements are as follows:

> "An Affiliate shall be a person who, by scientific acquirements or practical experience, is qualified to cooperate with engineers in the advancement of professional knowledge and practice, but who is not a professional engineer. He shall, at the time of his admission, be at least 32 years of age."

Proponents of this change state that it is desirable in the interests of simplicity and to make requirements for this grade conform with other proposed changes in membership grades in case they should be authorized.

18. The questionnaire also contains questions of informational and statistical nature, and no comment on them is presented here. CIVIL ENGINEERING will carry a report on the result of the questionnaire on membership grades as soon as results have been tabulated, and full publicity will be given later to discussion of the subjects developed. It should be clearly understood by all members that this questionnaire is solely for the purpose of obtaining opinion on the questions proposed. None of the proposals can be put into effect without changes in the By-Laws or the Constitution, or both. If the information received through this questionnaire results in proposals for changes in the Constitution, and if the constitutional amendment is approved to give voting power to Juniors (to be voted on this fall), Juniors as well as present corporate members will be authorized to vote on such future constitutional amendments.

19. Do not fill out and return the copy of the questionnaire which follows as part of this statement. A separate reprint of the questionnaire for return will be transmitted to you in September 1947. Deadline for returns is October 15, 1947, and a report on analysis of the return will be published soon thereafter.

20. Attention also is directed to the questions covering statistical information which begin with Question 17. The Board of Direction urges all members to furnish this information.

The Board of Direction urges every member of the Society to give this statement and the questionnaire special consideration. Discuss it with fellow members and, if practicable, make it a subject for discussion at one or more Section meetings.

16. Do you favor retention of all titles and qualifications as

21. In what engineering activity are you most interested?

QUESTIONNAIRE

See Preceding Statement for Explanation of Questions on Membership Grade Structure.

NOTE: Questions from No. 2 to the final question require only that you circle appropriate code numbers.

1. Age last birthday in years_____.

2. Present membership grade in the ASCE:

Junior	**.1**	**Member or Hon. Member**	**.3**
Associate Member . .	**.2**	**Affiliate**	**.4**

3. Registered or licensed to practice as a professional engineer in one or more states? . . . . . **.5**

4. Veteran of:

World War I . . .	**7**	**At present in military**	
World War II . . .	**8**	**service**	**.10**
Both World Wars .	**9**	**Not U.S. War veteran**	**11**

5. If you are a war veteran, is it your opinion that while in the military service, the duties to which you were assigned were such that your engineering qualifications were used—to the fullest practicable extent . . . . **12**, at about half of your abilities . . . . **13**, at less than half your abilities . . . . **14**, not at all . . . . **15**.

(Circle one and only one of these four code numbers)

6. Citizen of United States?

Yes . . . . . **.16** **No** . . . . . **.17**

Membership Grade Questions

NOTE: The following table is presented to facilitate consideration of questions on proposed changes in membership grades.

MINIMUM AGE	PRESENT GRADE	PROPOSED GRADE
45	Honorary Member (no change)	Honorary Member
..	No present grade	Fellow
35	Member	Member
27	Associate Member	Member
20	Junior	Associate Member
35	Affiliate	.....
32	.....	Affiliate
..	No present grade	Student

Where paragraph references are given in the questions to follow, such references are to paragraphs of the statement which precedes this questionnaire, the references being shown as (Statement ¶ 8, Statement ¶ 10 etc.).

7. Do you favor the creation of a new senior corporate grade to be designated as "Fellow"? (Statement ¶¶ 14, 15, 16)

Yes . . . . . **.18** **No** . . . . . **.19**

8. Do you favor the amalgamation of the *present grades* of "Member" and "Associate Member" into a single new corporate grade to be known as "Member"? (Statement ¶¶ 10, 11, 13)

Yes . . . . . **.20** **No** . . . . . **.21**

9. Do you favor the creation of a *new corporate grade* of "Associate Member" to have the same qualifications as now provided for the present non-corporate grade of "Junior"; all present "Juniors" to become Associate Members upon creation of such grade? (Statement ¶¶ 10, 11, 12, 13)

Yes . . . . . **.22** **No** . . . . . **.23**

10. If you favor retention of present qualifications for the grade of Junior, do you favor:

(*a*) **Retention of the present title "Junior"** . . . . **.24**

(*b*) **Change of title to some other appropriate title not carrying the word "Junior"** . . . . . **.25**

11. Do you favor giving members the Junior grade as presently constituted:

(*a*) **Full corporate rights as now enjoyed by Associate Members and Members:**

Yes . . . . . **.26** **No** . . . . . **.27**

12. If you favor the creation of a *new* corporate grade of "Associate Member" as outlined in question 9: Do you favor full corporate rights for such new grade:

Yes . . . . . **.28** **No** . . . . . **.29**

13. Do you favor creation of a *new* non-corporate grade to be known either as "Student" or "Student Member" (Circle one code number)

(*a*) **"Student" Yes** . **.30** **No** . . . . . **.31**

(*b*) **"Student Member" Yes** . **.32** **No** . . . . . **.33**

14. If your answer to question 13 is "Yes," should membership in the grade of "Student" or "Student Member" be open to:

(*a*) **All engineering students** . . . . . **.34**

(*b*) **Upper classmen only** . . . . . **.35**

15. Do you favor the modification of the requirements for the grade of "Affiliate" (Statement ¶17)

Yes . . . . . **.36** **No** . . . . . **.37**

CONCRETE

16. Do you favor retention of all titles and qualifications as presently defined in the constitution for the several grades of membership in the Society?

Yes . . . . . .38 **No** 39

For Information and Statistics

17. My occupational status is: (Circle only one code number)

Owner or part owner of a business or a private or governmental supervisory employee responsible for all or any of the following:

Hiring, discharging, effectively recommending changes in pay rates, major changes in assignments, etc. 47

A non-supervisory employee 48

18. My major occupational field is: (Circle only one code number)

Private consulting practice, in any capacity 49
Teaching or administrative member of a faculty . . .50
Contracting business, in any capacity 51
Manufacturing business, in any capacity 52
Public utility, in any capacity 53
Other private business related to engineering . . .54
Private business not related to engineering 55

Employee of Government:

Federal . . . . .56 **State** 57
County . . . . . .58 **Municipal** 59
Other public authority 60
Retired 61

19. In what District of the Society is your residence recorded: that is, in what Society district is the location of the address to which your Society mail is sent. (See map in current Year Book)
NOTE: Circle one and only one code number.

DISTRICT	CODE NO.	DISTRICT	CODE NO.
1	.01	9	.09
2	.02	10	.010
3	.03	11	.011
4	.04	12	.012
5	.05	13	.013
6	.06	14	.014
7	.07	15	.015
8	.08	16	.016

Do not know 017

Civil Engineering Magazine

The following questions pertain to the official monthly magazine, American Society of Civil Engineers, CIVIL ENGINEERING, and its value to you.

20. Do you read CIVIL ENGINEERING? (Circle one code number)

Thoroughly . .62 **Spottily** . . . . . .63 **Not at all** 64

21. In what engineering activity are you most interested? (Circle one code number)

Airways 65
City Planning 66
Construction 67
Engineering Economics 68
Highways 69
Hydraulics 70
Irrigation 71
Power 72
Sanitary Engineering .73
Soil Mechanics . . .74
Structural 75
Surveying & Mapping 76
Waterways 77
Not listed 78

22. Are you most interested from the point of view of: (Circle one code number)

Construction .79 **Design** . . . . . .80 **Any other** 81

23. What departments of CIVIL ENGINEERING interest you most? (Circle only three code numbers)

	1ST CHOICE	2ND CHOICE	3RD CHOICE
Articles	82	90	100
Society News	83	91	101
Engineers' Notebook	84	92	102
News Briefs	85	93	103
Letters from Readers	86	94	104
New Equipment & Available Literature	87	95	105

24. Do you usually read the advertisements in CIVIL ENGINEERING?

Yes . . . . . 110 **No** 111

25. In your work, do you direct the procurement of equipment or materials? (Circle one code number)

Buy . .112 **Specify** . .113 **Both** . .114 **Not at all** . .115

26. What technical magazines in your fields of interest do you prefer to help you in your work? (Circle only three code numbers)

	CHOICE		
MAGAZINE	1st	2nd	3rd
Civil Engineering	120	131	142
Engineering News Record . . .	121	132	143
Construction Methods	122	133	144
Western Construction News .	123	134	145
Public Works Magazine . . .	124	135	146
Roads and Streets	125	136	147
Better Roads	126	137	148
Water Works Engineering . .	127	138	149
Water & Sewage Works . . .	128	139	150
American City	129	140	151
Other, not listed	130	141	152

Final Note

This is an anonymous questionnaire. Signatures are not desired.

CONCRETE EXPRESSWAYS like this...

The concrete paved Davison Limited Access Highway is helping Detroit avert traffic chaos. It provides non-stop travel with no intersections at grade through a solidly built-up neighborhood. One-way service drives carry local traffic.

A traffic "bottleneck" on Chicago's West Side. Intersections and cross traffic at grade, stop lights, and left turns, create a "bumper-to-bumper" battle, which brings motor and pedestrian movement to a virtual standstill. (Chicago Daily News Photo)

Help end Congestion like this...

URBAN expressways, designed in accordance with careful traffic studies, are the highway engineer's answer to the growing problem of traffic congestion.

The importance of these facilities calls for a type of pavement giving many years of uninterrupted service at lowest possible expense for maintenance—pavement such as portland cement concrete which *costs only one-fifth to one-half as much to maintain as other pavement.*

In addition to economy of upkeep, concrete pavement under most conditions, *actually costs less to build* than any other pavement of equal load-carrying capacity. These advantages in first cost and low upkeep through years of service, give *low annual cost*, the true measure of pavement economy.

Thousands of miles of concrete on main traveled roads—scores of expressways, have proved that concrete is not only the pavement which motorists prefer for all-weather safety but the most economical pavement for modern traffic.

Free copy of new book, "Concrete Pavement Design," will be helpful in planning roads and streets carrying all classes of traffic. Sent only in United States and Canada.

PORTLAND CEMENT ASSOCIATION

Dept. A7-13, 33 W. Grand Ave., Chicago 10, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

New Publications

Village Planning. A 76-page, illustrated plan for Glendale, Ohio, a residential community north of Cincinnati, has been prepared by the engineering firm of Harland Bartholomew, M. ASCE, at the request of the Village Planning Commission. The objective of this comprehensive plan for the entire community has been to ensure the spending of public and private funds for the right type of development and improvement.

Sewage Disposal. For distribution to veterans and builders in connection with the Veterans Housing Program, the U.S. Public Health Service has made available a revised bulletin of the recommendations of the Joint Committee on Rural Sanitation. This bulletin, which is entitled *Individual Sewage Disposal Systems*, is distributed by the Office of the Housing Expediter, Washington 25, D.C.

State Department Publications. A cumulative list of the publications of the Department of State for the two-year period ending January 1, 1947, has been issued as Publication 2801. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Highway Research. Ten years of highway research are summarized in a recent bulletin of the Purdue University Engineering Experiment Station, issued as Research Series No. 99. K. B. Woods, M. ASCE, associate director of the Joint Highway Research Project, is author of the bulletin, which may be obtained from the University Editor, Purdue University, Lafayette, Ind.

Wood Construction. Modern utilization of wood, based on engineering laboratory tests, is outlined in "Engineering with Wood," which has been reprinted from the April 1947 issue of the *Virginia Tech Engineer*. Inquiries should be addressed to E. George Stern, M. ASCE, director of the Wood Research Laboratory at Virginia Polytechnic Institute, Blacksburg, Va.

Sewerage Service Charges. A 74-page handbook of procedure and information on sewerage service charges in Texas—by Samuel R. Wright, M. ASCE, head of the civil engineering department of Texas A. & M. College—has been issued as Bulletin No. 98 of the Texas Engineering Experiment Station. The bulletin may be obtained from the Texas Engineering Experiment Station, College Station, Tex.

Water Resources. Further studies of the Ohio Water Resources Board, prepared in cooperation with the Water Resources Branch of the U.S. Geological Survey, are now available in mimeograph form and may be purchased from the Ohio Water Resources Board, Columbus, Ohio, at a cost of $1 a copy. Two recent reports are Bulletin No. 5, "Summary of Ground-Water Conditions in Ohio," and Bulletin No. 9, entitled "The Flood of June 1946 in Wayne and Holmes Counties, Ohio."

Welded Structures. Specifications for the application of metal-arc welding to the fabrication, field assembling, and repair of highway bridges are covered in the fourth edition of *Standard Specifications for Welded Highway and Railway Bridges* issued by the American Welding Society. The present edition, replacing the 1941 edition, introduces a new concept in design formulas. Copies may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N.Y.

Industrial Apprenticeships. An explanation of the operation and development of apprenticeships in American industry is given in a recent Department of Labor bulletin, entitled "The National Apprenticeship Program." Copies of this informative pamphlet may be obtained without cost by communicating with Apprentice-Training Service, U.S. Department of Labor, Washington 25, D.C.

Highway Administration. Functions, objectives and recent accomplishments of the Committee on Highway Organization and Administration of the Highway Research Board are summarized in the Board's Bulletin No. 3. Inquiries should be addressed to the Highway Research Board of the National Research Council, Washington 25, D.C. R. L. Morrison, M. ASCE, is chairman of the Board for 1947.

Bell-Bottom Screw Jacks. A revision of previous recommendations on bell-bottom screw jacks has been announced by the National Bureau of Standards. The present issue, entitled "R97-47, Bell-Bottom Screw Jacks," may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 5¢ a copy. A discount of 25 percent is allowed on orders of 100 or more copies.

Traffic Safety. As part of its campaign to reduce traffic accidents, the Eno Foundation for Highway Traffic Control has made available reprints of "Influence of Parking on Accidents"—by Wilbur S. Smith, Assoc. M. ASCE, technical adviser to the Foundation—from the April 1947 issue of *The Traffic Quarterly*. Requests for copies should be addressed to the Eno Foundation at Saugatuck, Conn.

Geological Survey Maps and Reports. A number of new maps and reports have been released by the U.S. Geological Survey. Unless otherwise noted, they may be obtained from the Director, Geological Survey, Washington 25, D.C. The list of new publications includes:

Missouri Basin Studies No. 16 entitled "Metallic Mineral Deposits of Montana"; price 30 cents.

Oil and Gas Investigations Preliminary Chart, entitled "The Tertiary Stratigraphy of the Jackson Hole Area, Northwestern Wyoming"; price 60 cents.

Oil and Gas Investigations Preliminary Map 66, entitled "Geology of the Western Part of the Ouachita Mountains of Oklahoma"; price $1.

Report on "Geology and Ground-Water Resources of the Wellton-Mohawk Area, Yuma County, Arizona." A limited number of copies available at the Survey Office, 408 North Fourth Avenue, Tucson, Ariz.

"Progress Report on Ground Water Conditions in the Cortland, N.Y., Quadrangle." May be obtained at the Survey office, 444 Broadway, Albany, N.Y.

Two magnetic maps of the "crypto-volcanic" area in the vicinity of Kentland, Ind. They may be examined in the Office of the State Geologist of Indiana, Bloomington, Ind., and at the Survey office in Washington.

A colored map of Colorado (Missouri Basin Studies No. 10) showing the locations of non-metallic mineral deposits and of rocks suitable for construction material may be purchased for 80 cents at the Survey offices in Washington and Denver, Colo.

Two reconnaissance reports on iron-ore deposits in the Clearwater district and the Washington County district of Idaho may be consulted at the Survey offices in Washington and Spokane, Wash., and at the office of the Director, Bureau of Mines and Geology, University of Idaho, Moscow, Idaho.

Demands Building Codes Be Revised for Fire Safety

CONCEDING THAT OWNERS of older buildings naturally object to the expense of remodeling them for safety from fire, Maj. Gen. Philip B. Fleming, M. ASCE, Federal Works Administrator and general chairman of the President's Conference on Fire Prevention, reported in a recent address that the Conference's Committee on Laws and Law Enforcement had found no legal obstacle to requiring such action. However, "some additional legislation may be needed to provide for the long-term financing of needed alterations," he told the Southern Regional Conference of the Council of State Governments in Washington.

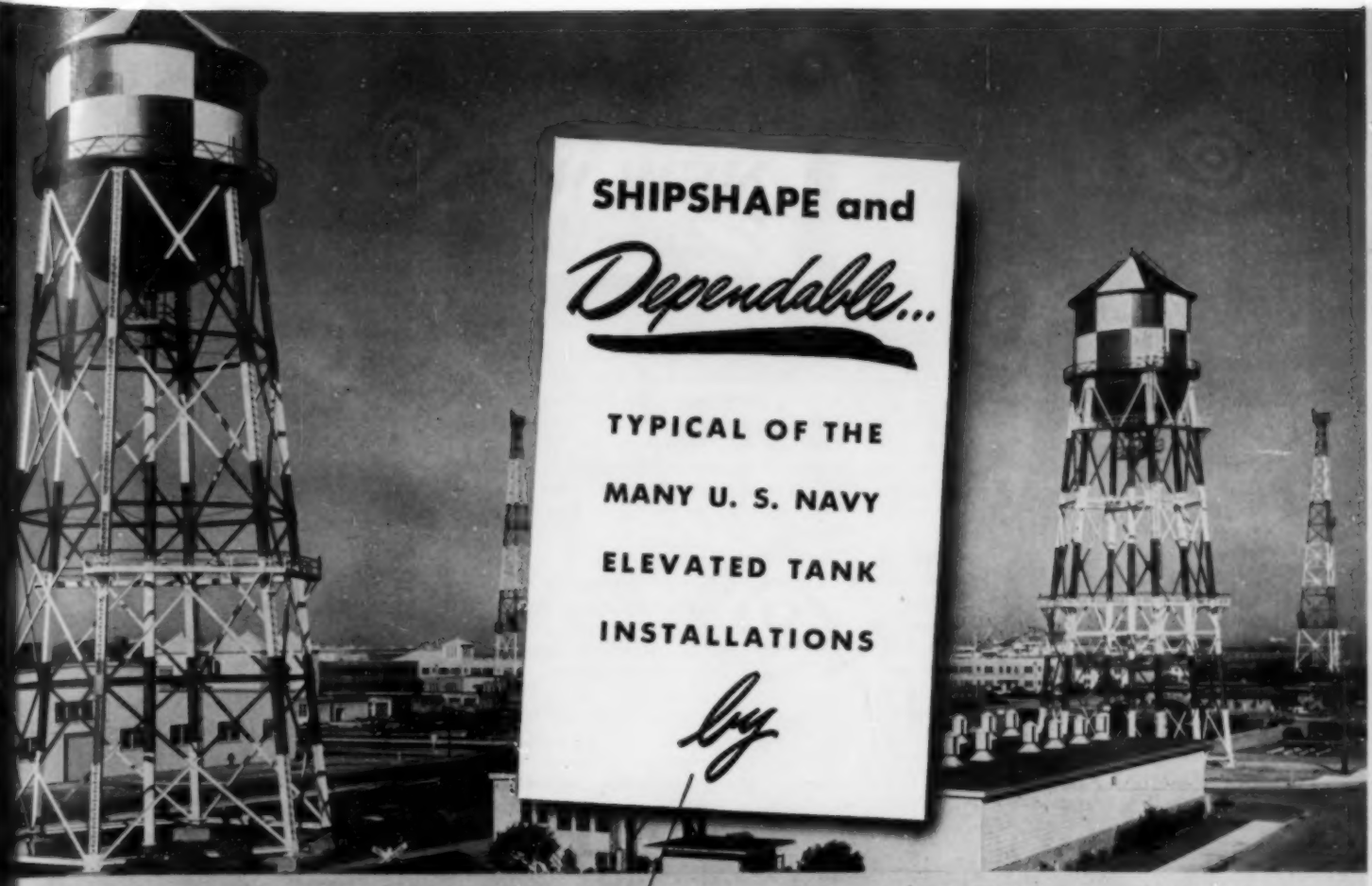
Unless thousands of existing structures are remodeled, similar disasters will follow the Winecoff Hotel and Cocoanut Grove fires, he warned. General Fleming demanded a nation-wide campaign for adoption or revision of building codes and recommended that the Council of State Governments, the National Association of Attorneys General, the United States Conference of Mayors and the National Institute of Municipal Law Officers appoint standing committees with militant programs on building codes and fire-prevention ordinances.

Reduction of the nation's fire loss depends upon continuous effort, General Fleming emphasized. "No brief campaign," he said, "will accomplish any lasting benefits.

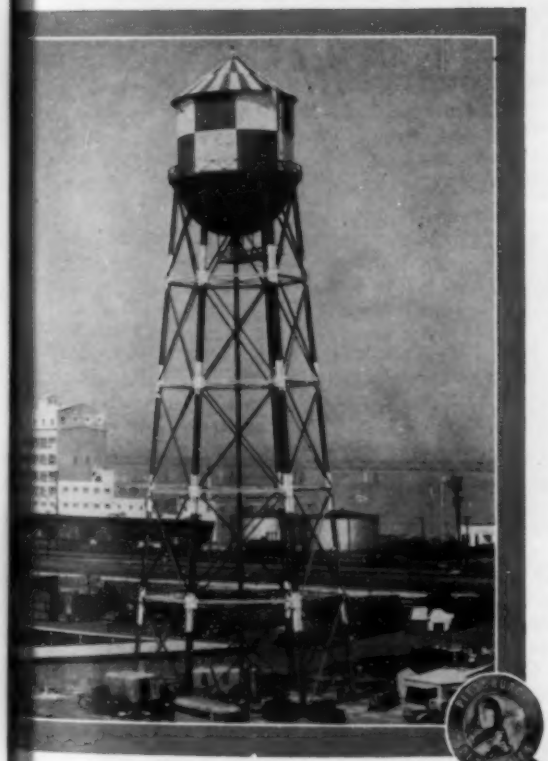
"Leadership must come from the highest officials of the states and municipalities and these officials must accept their direct responsibility for fire safety. This is especially true with respect to such public properties as schools, hospitals and other public buildings. State departments of education, for example, should take the lead in developing fire-safe school properties and designate responsibility for the successful completion of programs to accomplish the purpose."

General Fleming cited a National Bureau of Standards survey of 3,000 cities showing that a third of them had no building codes at all and that a majority of the others had codes more than 20 years old.

"But even the best municipal building code is useless unless it is adequately en-



PITTSBURGH · DES MOINES



Builders of Elevated Steel Tanks for Better Water Storage since

1897

These sturdy Elevated Steel Tanks, built by Pittsburgh-Des Moines to Navy specifications, are representative of hundreds of similar installations erected by us for the armed services. Above are shown the 250,000-gallon and 200,000-gallon P-DM tanks built at Alameda Naval Air Station (the wireless towers are ours, too!), and at left, the 200,000-gallon tank erected at the Oakland Naval Supply Depot.

As specialists in modern elevated steel tank design and construction, we invite your inquiries and will gladly arrange for consultation.

PITTSBURGH · DES MOINES
STEEL COMPANY

PITTSBURGH, PA., 3470 NEVILLE ISLAND—DES MOINES, IOWA, 971 TUTTLE STREET
NEW YORK, ROOM 951, 270 BROADWAY · CHICAGO, 1274 FIRST NATIONAL BANK BLDG. · DALLAS, 1275 PRAETORIAN BUILDING · SAN FRANCISCO, 677 RIALTO BUILDING · SEATTLE, 578 FIRST AVENUE, SOUTH

forced," he remarked. "The city building commissioner must be a man of integrity and of outstanding technical competence. In too many cities the position is treated as a political sinecure."

New Construction Equipment Will Speed Highway Work

TREMENDOUS IMPETUS to our lagging highway construction will come from the first postwar Road Show, according to J. T. Callaway, president of the American Road Builders' Association, sponsor of the show. This exposition of new construction equipment will be held at Soldier Field, Chicago, July 16–24, 1948.

"When Congress gave the 'green light' to highway departments back in October 1945, we confidently expected to do at least a billion dollars worth of road building in 1946," Mr. Callaway said. "Instead, lack of sufficient modern equipment, shortages of labor and materials, and contractual differences kept us far behind that estimate. Meanwhile our roads are wearing out, and maintenance costs shot ahead of construction expenditures. It is now believed that it will take 15 years and an outlay of more than $20 billion to bring our highways up to modern standards.

"Manufacturers will exhibit at the 1948 Road Show for the first time the labor- and time-saving equipment they have been developing on their drawing boards and in their testing laboratories since the war," ARBA's president continued. "This not only will give momentum to road building, but will mean real saving of the taxpayers' highway dollars for these new machines will build better roads faster."

Inter-American Sanitary Group Offers Charter Memberships

SANITARY ENGINEERS and those engaged in allied activities are invited to become charter members of the Inter-American Association of Sanitary Engineering, recently formed by more than 400 sanitary engineers, public health and public works administrators, chemical and civil engineers from the 21 American republics. The association is the result of two meetings held in 1946 in Rio de Janeiro, Brazil, and Caracas, Venezuela. (See CIVIL ENGINEERING for February 1947, page 96.)

Solution of sanitation problems and formulation of sanitary standards for the protection of the people of the Western Hemisphere are the principal aims of the association, which it is expected will hold its first official conference in Santiago, Chile, in November of this year.

Charter membership is available to those interested on payment of annual dues of $3, which includes a subscription to the association's journal. Information may be obtained from Homer J. Hayward, Assoc. M. ASCE, U.S. Representative of the Membership Committee, Inter-American Association of Sanitary Engineering, N.W. Corner 17th and Constitution Avenues, Washington 6, D.C.

NEW IN Education

CASE SCHOOL OF APPLIED SCIENCE has just graduated its last class under the name it has borne since its founding in 1880. Effective July 1, 1947, it becomes Case Institute of Technology by action of its board of trustees. Approximately 10,000 students have attended the school since its founding, of whom 7,000 have received degrees.

LOUISIANA STATE UNIVERSITY will open a School of Hydraulic Engineering as a division of the College of Engineering beginning with the 1947–1948 school session. The new school will be directed by Prof. Glen N. Cox, M. ASCE. Work leading to the master of science degree will be offered, normally requiring one 12-month year. Through a cooperative agreement with the Corps of Engineers, some students will be assigned to work at the U.S. Waterways Experiment Station, Vicksburg, Miss., for about four months. Normally applicants for admission should have a bachelor's degree in the upper third of the graduating class in an engineering curriculum approved by ECPD. All inqui ies are to be addressed to Dr. Glen N. Cox, director, School of Hydraulic Engineering, Louisiana State University, University Station, Baton Rouge, La.

SOME 300 Cooper Union engineering students and 18 faculty members will have attended sessions at the school's 1,000-acre Green Engineering Camp in the Ramapo Mountains at Ringwood, Passaic County, New Jersey, between June 16 and July 12. First-year students will be at the camp for two-week periods and advanced students for three weeks, Prof. John O. Eichler, Assoc. M. ASCE, in charge of summer classes, announced. Costs of the summer session are met by the Cooper Union. Freshmen students will be at the camp for an orientation program in September. The camp is also used by student groups for weekend recreation throughout the year.

DISPOSAL OF PLATING-ROOM wastes is the subject of a new research project established at Yale University by the American Electroplaters' Society. This is the tenth of a series of projects set up as fellowships or grants at leading universities and research institutions, relating to various practical aspects of the electroplating and metal finishing industry. These projects are supported by allotments from regular membership dues, by voluntary contributions, and by industrial concerns through payment of sustaining membership dues to the society.

RENSSELAER POLYTECHNIC INSTITUTE will be the nation's largest privately endowed school of science and engineering in September, exclusive of graduate and evening students, President Livingston W. Houston reported at the annual meeting of the Rensselaer Alumni Association. Enrollment in the fall will exceed 4,500, three times the prewar level, the president stated.

THE EXPERIMENTAL TOWING TANK Laboratory of Stevens Institute of Technology, Castle Point, Hoboken, N.J., has awarded its fourth fellowship to George R. Holladay of Rapidan, Va. Fellowships are limited to five at one time and since work is on an individual basis, applications and appointments may be made at any time during the year. Fellows work as regular members of the staff on actual research programs during the operating hours of the tank, thus gaining experience in the broader principles of hydrodynamic research in which the tank is engaged.

A TWO-STORY FRAME BUILDING constructed for the U.S. Army at Camp Shanks, was transformed to use in the civilian education program when it was reerected about 60 miles away at the engineering camp of Stevens Institute of Technology near Johnsonburg, N.J. The building, given to the college by the government, was taken down, moved, and reconstructed by the PWA as part of the program to help educational institutions handle their record postwar enrollment. It increases the camp's capacity from 200 to 300 students.

GEORGIA TECH SIGMA XI CLUB will award an annual prize of $300 each year for the outstanding research paper published by a member of the school's faculty. The recipient will give the Sigma Xi Prize Lecture as a part of the commencement week exercises. The program for the lecture ceremonies will include a complete list of all research papers in science and engineering published by faculty members during the previous year.

CHINESE STUDENTS AND VISITORS tour of W. & L. E. Gurley Co. plant, Troy, N.Y., initiates program to familiarize foreign students of Rensselaer Polytechnic Institute with production methods. Visitors from China investigating telescope solar transit are Z. T. Tsang and Sidney Tsai, representing Chun Ho Co., Shanghai importers and exporters handling Gurley instruments, who addressed Chinese students at dinner preceding tour of plant.

CLAY PIPE has again been selected for this important additional district sewer line on Route 21 south of Brecksville, Ohio, to serve both the expanding residential community and a new industrial research laboratory. The installation was engineered by Frank L. Woodruff, Cuyahoga County Sanitary Engineer. Contractors were D. M. Sylvester and P. DiPaolo.

SANITARY DISTRICT GIVES CLAY *the O.K.!* AGAIN AND AGAIN

ON big *district* jobs where sewer line materials must be okayed by many different engineers, notice how frequently Clay Pipe gets the nod. Clay Pipe meets with universal approval, because it is the "natural" material for sewerage use. It doesn't crumble or corrode under the effects of sewerage acids or strong industrial wastes. It can't rust. And Clay Pipe *never* wears out! For information about Clay Pipe, write to the nearest regional office listed below.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

111 W. Washington St., Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
703 Ninth & Hill Bldg., Los Angeles 15, Calif.

CLAY PIPE

CLAY PIPE NEVER WEARS OUT!

C 647 2

NEWS OF Engineers

Charles F. Kettering, Honorary Member of the ASCE, has retired as vice-president of the General Motors Corp., in charge of research. Mr. Kettering, who has been connected with General Motors since 1920, will keep an office in the General Motors Research Building in Detroit and continue his research work on the development of a new high compression automobile engine, fuels, and other projects still in the laboratories. According to Mr. Kettering, the new engine will eventually cut the motorists' fuel bill by approximately a billion dollars a year. Mr. Kettering's many inventions include the automobile self-starter and the Delco Farm Lighting System.

C. F. Kettering

Raymond D. Mindlin, associate professor of civil engineering at Columbia University, received the Class of 1889 Medal at the university's recent graduation exercises "for distinguished service to country, profession, and school." Other alumni honored at the Columbia commencement were ASCE members **Gavin Hadden** and **D. B. Steinman,** who received the University Medals for Excellence.

Thomas W. Roby has been promoted from the position of valuation engineer for the Seaboard Air Line Railroad Co., to that of chief of research and planning, with headquarters at Norfolk, Va.

William H. Oswalt recently resigned as assistant to the city manager of Dallas, Tex., to accept an appointment as city manager of Jacksonville, Tex.

Harvey F. Ludwig and **Vinton W. Bacon** have opened a sanitary engineering consulting office in Pasadena, Calif., under the firm name of Ludwig & Bacon. Both served with the U.S. Public Health Service during the war, and for the past year have been conducting field operations for the Orange County (California) sewerage survey.

Harold H. Kidder is now project superintendent of the U.S. Bureau of Reclamation project at Carlsbad, N.Mex., where he will manage the irrigation system and reservoirs on the Pecos River, and direct plans to rehabilitate the old irrigation works. He was formerly an engineer in the Bureau of Reclamation regional office at Amarillo, Tex.

Henry Earle Riggs, Past-President and Honorary Member of the ASCE, was guest of honor at a recent dinner given by the Rotary Club of Ann Arbor, Mich., to celebrate his 82nd birthday. Dr. Riggs is honorary professor of civil engineering at the University of Michigan, where he was for many years head of the civil engineering department.

Blase Nemeth, who was recently released from the Army Corps of Engineers, with the rank of major, has accepted a position with the firm of Concrete Products and Engineering Co., Inc., in Jacksonville, Fla. Mr. Nemeth entered the Corps of Engineers in 1941, and for the past three years has been executive officer in the Jacksonville office of the U.S. District Engineer.

Benjamin A. Morgan, Jr., formerly construction engineer for the Celanese Corp., of America, has been appointed director of Construcciones y Fomento Michoacan, S.A., with headquarters at Zacapu, Mexico. His company is employed on the construction of a new rayon plant for Viscosa Mexicana, S.A.

Garvin H. Dyer has resigned as secretary and assistant superintendent of the Springfield City (Mo.) Water Co., to become manager of the Missouri Water Co., at Independence, Mo.

Francis R. MacLeay, chief engineer for the Corbetta Construction Co., of New York City, has been appointed chairman of the New Rochelle Municipal Housing Authority, New Rochelle, N. Y.

Ralph M. Hansen has opened a civil engineering and surveying office in Kalamazoo, Mich. He will specialize in land development, surveys and planning, airport and railroad track design and layout, and sewerage and drainage. Until lately Mr. Hansen was connected with Louis C. Kingscott & Associates, of Kalamazoo.

John D. Hancock is now airport engineer for the Civil Aeronautics Administration at Fort Worth, Tex. Mr. Hancock was recently released from the Army Air Corps after six years of service, with the rank of lieutenant colonel. During this period he was engaged in airfield planning and construction in all theaters of the war.

Reed McKinley has been promoted from the position of city engineer of Kansas City, Mo., to that of director of public works. He will be succeeded as city engineer by **John E. Maring,** since 1943 Kansas City commissioner of streets and sewers. Both engineers have been connected with the Kansas City department of public works for a number of years.

Reed McKinley

John E. Maring

H. Fred Martin has resigned as sales engineer for the International Filter Co. in Texas to accept the position of vice-president of the Garrett Engineering Co., in Houston, Tex.

T. R. Hance and **Walter L. Woodward** have been appointed to the engineering faculty of Gonzaga University in Spokane, Wash. Mr. Hance was formerly stress analyst for the Ryan Aeronautical Co., of San Diego, Calif., and Mr. Woodward regional engineer for the U.S. Indian Service in Spokane.

Frank Kerekes, professor of structural engineering at Iowa State College, has been appointed assistant dean of engineering at that college. He has been on the civil engineering staff there since 1920, and has been a full professor since 1931. Professor Kerekes has been active in the Iowa Engineering Society and the American Society for Engineering Education, and is author and co-author of a number of articles and books on engineering education and technical writing and drawing. His most recent volume, *Supplementary Notes for Engineering Reports,* co-authored by Robley Winfrey, M. ASCE, was reviewed in the May issue.

Frank Kerekes

Neil M. Loney, formerly chief works engineer for the Fisher Body Division of General Motors, has established an industrial consulting practice in Detroit, Mich. He will specialize in plant construction.

Raymond E. Layton has severed his connection as civil engineer for the International Engineering Co., of Denver, Colo., to accept a similar position with the Chicago consulting firm of Consoer, Townsend & Associates.

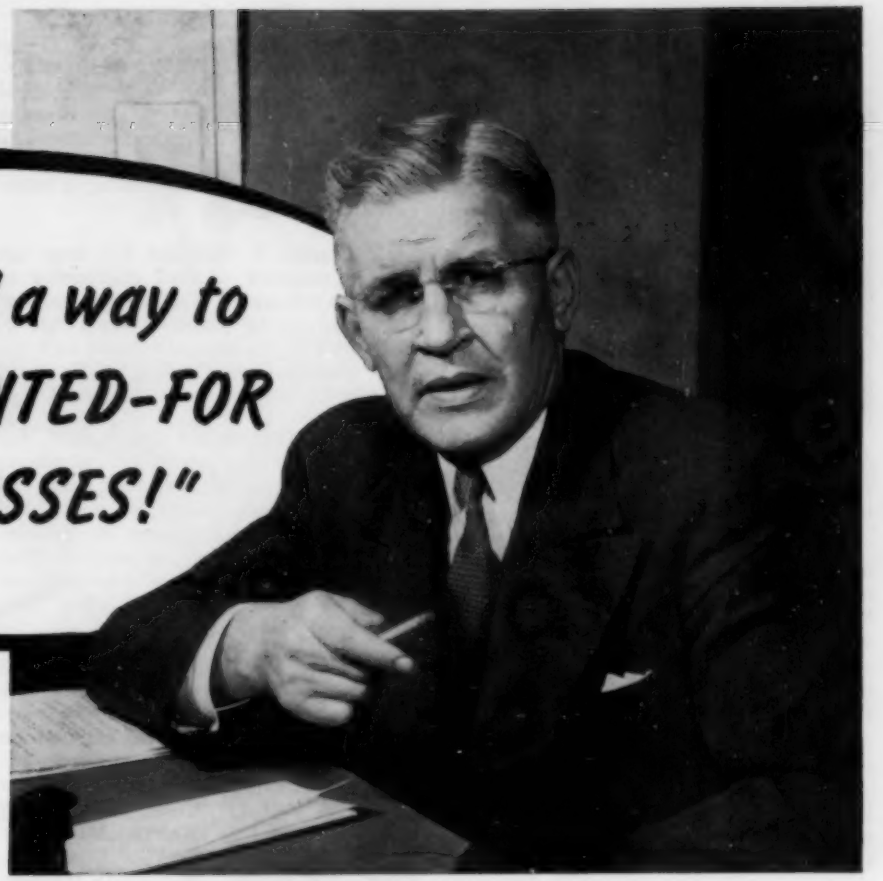
Kenneth S. Lane has been transferred from Providence, R.I., where he was head of the soils laboratory at the U.S. Engineer Office, to Bismark, N.Dak., where he is chief of the soils and geology branch on the design of Garrison Dam.

Robert H. Fraser has established a consulting practice at 154 Nassau Street, New York, N.Y. He will specialize in the design of structures, heating and ventilating, and plumbing and electrical work.

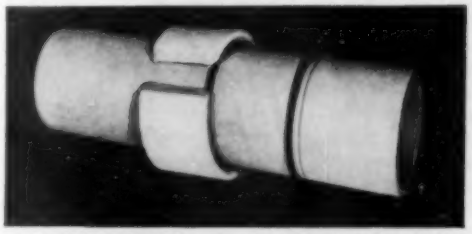
R. C. Keeling, Kansas state highway engineer, was recently elected president of the Mississippi ValleyConference of State Highway Officials.

H. Oakley Sharp, professor of geodesy and transportation engineering at Rensselaer Polytechnic Institute, has been named chairman of a joint committee for New York State as part of a nation-wide movement to bring about more uniformity in the surveying and mapping of lands. The four national organizations cooperating in the program are the ASCE, the American Society of Photogrammetry, the American Congress on Surveying and Mapping, and the American Society for Engineering Education.

F. L. Nicholson, chief engineer of the Norfolk Southern Railway Co., is retiring after 57 years of service. He is a former Director of the ASCE.



Water Works men find Transite's Simplex Couplings guard against joint leakage.



CUTAWAY VIEW shows the Simplex Coupling at start of assembly. Note the position of the Transite sleeve and two rubber rings.

FINAL POSITION. The Transite sleeve has now been pulled over the ends of the pipe, rolling and compressing the rubber rings tightly into position.

"Water pumped but not paid for" is a hidden item in the books of many municipal water departments. A considerable part of this loss can often be traced to underground leakage—a loss which Transite Pipe has helped to reduce in hundreds of cities and towns.

An important reason for this is Transite's Simplex Coupling. Engineered to combine tightness with an unusual degree of flexibility, this coupling cushions the line against vibration, helps compensate for soil movement and earth stresses. Thus, it provides an effective safeguard against leakage at the joints.

Moreover, the Simplex Coupling is, in effect, a factory-made joint which is simply *assembled* on the job. Perfect joints are quickly, easily made, even by inexperienced crews. And each joint can be checked for proper assembly as the pipe is laid—additional insurance against joint troubles due to faulty workmanship in the trench.

Let us send you more information about the many advantages of Transite Pipe. Just write Johns-Manville, Box 290, New York 16, N. Y., and ask for the Transite Pressure Pipe brochure.

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Transite Pressure Pipe

An Asbestos Product

Philip Sporn has been elected president of the American Gas and Electric Co. and of its engineering and management subsidiary, the American Gas and Electric Service Corp., New York City. He joined the staff of the organization in 1920, becoming chief engineer in 1933 and vice-president in charge of all engineering operations in 1934. Mr. Sporn received the 1945 Edison Medal of the A.I.E.E. and the 1946 Egleston Medal of Columbia University for his contributions in the field of utility engineering.

Philip Sporn

Ernest E. Michaels, until lately manager of the Birmingham, Ala., plant of the Chicago Bridge & Iron Co., has been appointed manager of operations for the company, with headquarters in Chicago.

Wilbur W. Davis is retiring as chief engineer of the Boston Transit Department. His home is in Melrose Highlands, Mass.

Gilmore D. Clarke, New York City consultant and landscape architect, has been elected to membership in the American Academy of Arts and Letters. The Academy has a total membership of only 50, and Mr. Clarke is one of three elected to its roster in the past year.

Bradley G. Seitz is now in the hydraulic equipment design section of the U.S. Bureau of Reclamation in Denver, Colo. Until lately he was in charge of the hydraulic and hydrologic design section of the U.S. Engineer Office at Syracuse, N.Y.

Edward Silberman, previously with the Airways Engineering Division of the Civil Aeronautics Authority, has accepted a position as research associate at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota.

Frank Belick was recently appointed to the staff of the city engineer of San Jose, Calif., where he will be engaged on the public works department's project of separating the city's storm and sanitary sewers.

William Henry Mitchell, who served during the war in the Navy Civil Engineer Corps, is now on the engineering staff of the Stone & Webster Engineering Corp., Boston, Mass.

Henry J. Larsen has been appointed chief engineer and member of the Pittsburgh consulting firm of Hunting, Larsen & Dunnells, Inc., formerly Hunting, Davis & Dunnells. Mr. Larsen was previously construction project manager of the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

Ralph L. Bloor, of Bay Ridge, Md., has been appointed chief engineer in the Office of the Chief of Engineers, Washington, D.C. He succeeds **Raymond W. Stuck,** who has resigned to accept an assignment with the World-Wide Development Corp., of New York.

Patrick B. Smith is now city engineer of Coffeyville, Kans. He has recently been employed on the construction of several sewage-treatment plants in Kansas.

Carl A. McClelland has retired as hydraulic engineer for the U.S. Geological Survey at Santa Fe, N.Mex., after 23 years in government service. He has moved to Los Angeles, Calif., where he will continue to do consulting work, specializing in irrigation and drainage.

Dr. Harold V. Hawkins has been appointed professor of civil engineering at Illinois Institute of Technology, the appointment to be effective September 1. Since 1941 he has been associated with the Bell Aircraft Corp., Buffalo, N.Y., most recently as chief electronics engineer.

Betram D. Tallamy, of Buffalo, N.Y., has been promoted from the position of deputy superintendent of the New York State Department of Public Works to that of chief engineer, with headquarters in Albany, N.Y. In his new post he succeeds **Maj. Gen. Thomas F. Farrell,** who has resigned to become New York City Housing Commissioner.

Thomas P. Pendleton recently retired as chief topographic engineer for the U.S. Geological Survey. Except for five years as chief engineer for a private firm and two years in the Coast and Geodetic Survey, Mr. Pendleton has spent his career with the Geological Survey, having gone there in 1905. An authority on photogrammetry, surveying and mapping, Mr. Pendleton was largely responsible for the adaptation and development of the "multiplex" method of topographic mapping. He is the author of numerous technical articles on photogrammetry and mapping, and co-author of Bulletin 788, "Topographic Instructions of the U.S. Geological Survey." He will be succeeded as chief topographic engineer by **Gerald FitzGerald.**

T. P. Pendleton

Dean G. Edwards and **Guy Kelcey,** New York City consultants under the firm name of Edwards & Kelcey, have opened a branch office in Newark, N.J., which will be headquarters for assignments from the New Jersey State Highway Department in connection with the planning of the Essex County east-west highway. **William L. Hanavan** will be in charge for the firm of the layout and preliminary design of the freeway across the Bayonne peninsula, and **Ladis Csanyi** will direct the traffic study and highway location for the freeway facilities through the Newark metropolitan area.

Louis R. Howson, Chicago consultant, is the recipient of the current John M. Goodell Prize of the American Water Works Association. The award—made annually for "the most notable contribution to the science or practice of waterworks development"—goes to Mr. Howson for a paper on "Guides and Checks on Water Works Operations," which was published in the January 1946 issue of the journal of the Association.

Deceased

Thomas Franklin Boltz (Assoc. M. '09) retired civil engineer of Clearwater, Fla., died in a hospital there on May 22. Mr. Boltz, who was 71, worked on the Nicaragua Canal and the Panama Canal. After his return to the United States in 1908, he was for many years connected with the Portland Cement Association, serving for some time as district engineer at Parkersburg, W.Va. At the time of his retirement in 1944, he was manager of the Universal Concrete Pipe Co., at Waco, Tex.

Clarence Knight Conard (M. '09) of New Paltz, N.Y., died at his home there on May 16, at the age of 70. A veteran of the Spanish-American War and the First World War, Mr. Conard had served as construction engineer for the Baltimore & Ohio Railroad, the Erie Railroad, and the Southern Railway, and as an engineer for the Cuban government. At the time of his retirement in 1943, he had been on the engineering staff of the New York City Board of Estimate for 20 years.

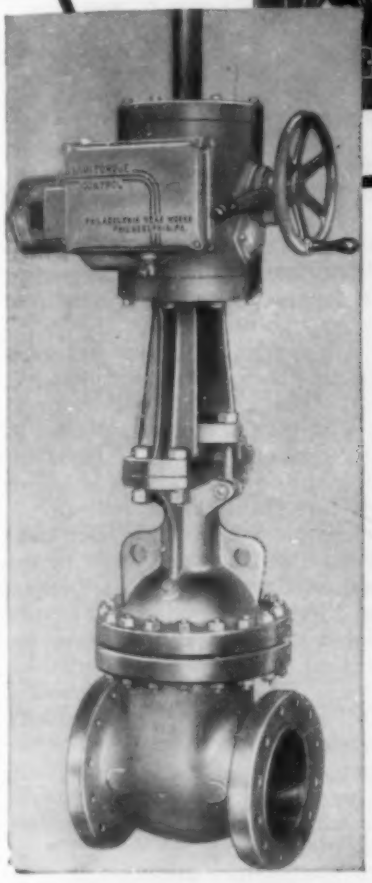
William Dollison Faucette (M. '21) executive representative of the Seaboard Air Line Railroad, Norfolk, Va., died at his home there on May 19. Mr. Faucette, who was 65, spent his entire career with the Seaboard system. He was chief engineer from 1913 to 1944, and had been executive representative since the latter date. For the past year he was also chairman of the railroad's Committee on Research and Planning. Mr. Faucette had served as member and chairman of a number of committees of the American Association of Railroads.

William Grover Kahl (Jun. '36) of Overland Park, Kans., died on April 13. He was 32 years old and an alumnus of the University of Illinois, class of 1936. While on the engineering staff of Consolidated Builders, Inc., Mr. Kahl made the hydraulic calculations for the Grand Coulee Dam construction program. More recently he was with the Panhandle Eastern Pipe Line Co., at Kansas City, Mo.

Francis William Perry (Assoc. M. '09) retired principal engineering assistant of the New York City Department of Plant and Structures, died at his home in Brooklyn, N.Y., on May 22. Colonel Perry, who was 71, began his career with the city in 1897 and remained until his retirement in 1935. His work during this period included the design of the Highbridge steel arch over the Harlem River, supervision of the erection of the Municipal Building, and service as the first city Director of Transportation. In the first World War he served overseas, and later was commanding officer of the 360th Engineers Reserve. He was a Life Member of the ASCE.

Francis W. Perry

Push-Button CONTROL OF VALVES WITH Limitorque VALVE OPERATOR



The "Limitorque" (at left) is for valves working at low to medium temperatures, low to high pressures, and normal speed of operation.

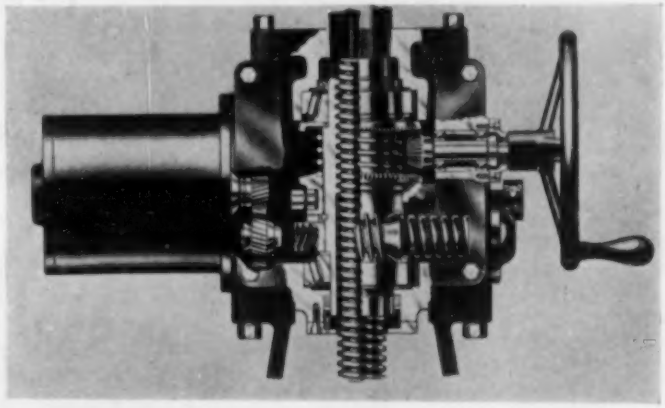
This Unit is mounted on top of valve yoke . . . no extra gears, nuts or bearings required. Stem nut is inside and furnished with Unit. Nut is directly inside worm gear which drives it. (All clutches and connecting sleeves are eliminated.)

Limitorque is designed for plug, cock, gate and globe valves . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts, without disturbing wiring.

A special high starting torque motor, reduction gears, limit switches all in one weatherproof assembly—and all electrical connections are made to one terminal board, easily accessible by removal of watertight cover. . . . Heat treated helical gears and hardened, ground and polished worm and bronze worm gear are used.

A handwheel is provided for manual operation and does not revolve during motor operation. During hand operation motor is mechanically disengaged. Limitorque is always operative electrically. No danger to operator should he be turning handwheel when motor is started, since automatic clutch disengages handwheel instantly, without shock. Declutch lever changes from motor to hand operation. The usual Limitorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.

Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided, because motor is shut off by thrust exerted on valve disc. Valve is protected during entire closing operation.



The word "Limitorque" has a definite meaning because an exclusive patented Torque Switch actually limits the torque applied to the operating parts.

FEATURES OF THE "SM" TYPE LIMITORQUE

1. Micrometer torque seating switch.
2. Self-contained unit—no gears, nut or bearings to buy.
3. Weatherproof, dust-tight and watertight construction.
4. Hammerblow device.
5. Non-rotating handwheel built into the unit.
6. Automatic declutching.
7. One terminal board for all electrical connections.
8. High torque motors.
9. Simple valve yoke.

Motor is coupled to worm shaft through helical gears. In closing, worm drives worm gear until lugs on the gear meet matching lugs on clutch. Torque is transmitted to the nut through splines connecting the clutch to stem nut. Torque spring is then compressed by axial movement of worm on worm shaft. When torque spring has been compressed to predetermined setting, torque switch is actuated by a tripping collar on worm shaft. This interrupts current to holding coil of controller and stops motor. Inertia of motor is absorbed in further compression of the torque spring. Opening travel is governed by geared limit switch.

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Former ASCE Director Frank A. Barbour Dies

FORMER ASCE DIRECTOR Frank A. Barbour, Boston consultant, died suddenly at his home in Framingham Center, Mass., on May 24. He was 77.

Born at St. John's, New Brunswick, Canada, Mr. Barbour was graduated from the University of New Brunswick. Following early experience in railroad location and construction in Canada and New England, he joined the engineering staff of the Boston Water Department. Later he was engaged on the design, construction, and operation of the Brockton, Mass., sewage disposal plant and in 1900 entered private practice in Boston w th F. H. Snow, who retired in 1905.

Frank A. Barbour 1870–1947

Mr. Barbour maintained his office until his death, specializing in water supply and purification, sewerage and sewage disposal, and appraisal of water properties. He also served as president of the New England Pressed Steel Co.

He was a former president of the American Water Works Association and the Boston Society of Civil Engineers, and president and honorary member of the New England Water Works Association. He had served on the editorial advisory board of *Water Works Engineering*, and was the author of numerous technical articles in the proceedings of the various engineering societies. During his term as Director of the ASCE (1934 to 1936) he served on the Committee on Publications.

George Alfred Maney (M. '28) professor of structural engineering at Northwestern University since 1928, died in Evanston, Ill., on May 10, at the age of 58. Before going to Northwestern, Professor Maney had taught at the University of Minnesota and had served as construction engineer on several large projects, including the Mississippi River bridge at Savanna, Ill., and the Santa Fe Railway terminal building in Dallas, Tex. He played an important part in the development of the slope-deflection method and of the deflection formula for reinforced concrete, and was the author of several prize-winning papers.

Robert Regnault Nace (M. '20) since 1928 chief engineer of the Pennsylvania Railroad's New York zone and of the Long Island Railroad, died in Elizabeth, N.J., on May 19. Mr. Nace, who was 64, had been with the railroad since 1901. He supervised the south Philadelphia track elevation, and from 1920 to 1928 was engineer of maintenance of way and superintendent of the Eastern Ohio, Schuylkill, and Indianapolis divisions.

Raymond Radbill (Assoc. M. '26) president of the Bituminous Service Co., of West Chester, Pa., died in February, at the age of 51. Mr. Radbill became connected with the Bituminous Service Co., in the capacity of manager in 1931, and had been president since 1939. For several years he was engineer for Good Roads, Inc., and during the first World War served overseas as assistant railway transportation officer.

John Green Reagan (Assoc. M. '21) of Cisco, Tex., died on April 16, at the age of 58. Mr. Reagan had served as chief engineer on the construction of water supply and sewage-disposal facilities for several Army camps in Texas, and on the construction of Williamson Dam at Cisco, Tex. He served the city of Cisco as city engineer and consultant, and for several years was a member of the contracting firm of Durland & Reagan, specializing in highway, sewer, and water-works projects.

Arthur Jacob Widmer (M. '20) since 1917 president of the Widmer Engineering Co., St. Louis, Mo., died in that city on April 30, at the age of 64. Mr. Widmer specialized in the design and construction of industrial plants, and the many structures on which he was engaged included the Railway Exchange Building in St. Louis. In the first World War, Mr. Widmer attained the rank of colonel of Engineers, and in the recent war headed an engineering field force of 500 on the construction of Army cantonments and training centers.

Navy-Constructed Aqueduct Supplies Water to San Diego

(*Continued from page 19*)

creting equipment is supplied by compressors located outside of the tunnel and was delivered through a 2-in. pipeline to a receiver tank which was in turn connected to the placers at the time of discharge. After each placer was emptied, it was pushed ahead onto a ramp which straddled the discharge pipe, and the next placer was brought into position and discharged. The ramp was constructed to accommodate four empty placers. A 6-in. steel discharge line deposited the concrete in place behind the steel tunnel lining forms.

The pneumatic equipment was not used for placing the concrete invert. A train of six end-dump cars hauled the concrete into the tunnel from the concrete batching plant, and the cars were dumped from an elevated track directly ahead of a slip form that was equipped with stationary vibrators. The elevated track and the slip form ride on a 3-in. curbing previously poured at the bottom of each side of the arch. The screeding equipment was drawn slowly forward by an air hoist, shaping the invert as it was brought forward. Very little float troweling was required.

The tunnel lining in three of the tunnels was placed with a single piston concrete pump mounted on a flatcar which traveled on the tunnel track. A conveyor belt was used for transferring the concrete from the batch buggies to a feeder hopper which was installed on top of the concrete pump.

Six end-dump buggies each having a capacity of 16 cu ft were carried into the tunnel on a flatcar. As soon as they were emptied onto the conveyor belt, they were shuttled to one side of a platform which was also mounted on the tunnel track. A 6-in. steel discharge line approximately 160 ft long deposited the concrete behind the arch forms.

The concrete pump was also used for placing the concrete in the tunnel invert. The concrete was pumped into a receiving hopper attached to the forward end of a slip form which shaped the invert as it was drawn slowly forward by an air motor.

Telescopic steel forms were used to form the sides and arch of the horseshoe-shaped section; 18-in. by 24-in. doors, staggered on 5-ft centers provided access behind the forms for inspection and to permit internal vibration. The forms were assembled in 20-ft sections and were moved with a traveler which was mounted on the 24-in.-gage tunnel track. The traveler was equipped with hydraulic jacks which facilitated the handling of the tunnel forms.

The contractors were permitted to use an air-entraining agent which tended to improve the workability of the concrete, as well as reduce segregation on the longer tunnel hauls.

Two-Way Radio Communication

Owing to the great distances involved, and the sparsely settled regions through which the aqueduct is being constructed, it has proved most feasible to supplement the inadequate existing public communication systems with two-way radio communications. The Navy radio system consisted of a 50-w fixed station at Vista, Calif., and eight 25-w mobile stations which were placed in the vehicles of the field engineers and chief inspectors. The contractor working on the southern portion of the aqueduct and the tunnels in the central section, installed a 60-w FM

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Check over these features—features that bring savings in time and money in constructing foundations for buildings, bridges, piers, airports, highways: Monotubes' fluted, tapered construction permits faster driving with average job equipment; Monotubes are easily extendible to any required length, right on the job; Monotubes are easy to handle, light in weight; Monotubes' tubular design permits quick checking top to toe, before concreting.

Monotubes' many advantages can help get your construction jobs—large or small—started *right.* Available in gauge, size, and taper to meet varying soil conditions. For complete information, write The Union Metal Manufacturing Company, Canton 5, Ohio.

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system for both his fixed station in Escondido, Calif., and his mobile units. The contractor constructing the central section of the pipeline through rugged terrain has also insalled a similar two-way radio telephone system. All radio equipment has been authorized and licensed by the Federal Communications Commission, and each separate system operates on its assigned frequency This type of communication has been of material assistance in coordinating the supervision of construction, as well as in expediting the summoning of aid in cases of emergency or equipment breakdowns.

Although this project since its inception has been beset by many difficulties including material shortages and labor difficulties, it is now anticipated that delivery of Colorado River water will start in October, with final completion of all work early in 1948.

Design and Construction

The plans and specifications for the project were prepared under the direction of Walker R. Young, M. ASCE, Chief Engineer of the Bureau of Reclamation at Denver, Colo. Administration of construction is under the cognizance of Rear Admiral J. J. Manning, M. ASCE, Chief of the Navy Bureau of Yards and Docks. The Officer-in-Charge of Construction is Capt. Alden K. Fogg, Assoc. M. ASCE, Public Works Officer of the Eleventh Naval District at San Diego, Calif.

All illustrations are official U.S. Navy photographs.

Difficult Location Problems on Blue Ridge Parkway

(*Continued from page 24*)

sieve, and from 25 to 35 percent a 1/4-in. sieve. Compaction was by blading and dragging and by traffic. Provision was made for the optional addition of 10 percent of friable soil binder. No rolling was required. These early bases compacted slowly under traffic.

Present specifications require the base to be constructed in three layers, each to be mixed by blade machine or traveling mixer, and each to be spread, bladed, rolled and if necessary watered. Grading requirements call for 70 to 100 percent passing 1 1/2-in. sieve, 55 to 85 passing 1-in., 50 to 80 passing 3/4-in., 40 to 70 passing 1/2-in., 30 to 60 passing No. 4, 20 to 50 passing No. 10, 10 to 30 passing No. 40, and 5 to 15 passing No. 200 sieves. The part of the filler passing the No. 40 sieve is required to have a liquid limit of not more than 25+ and a plasticity index of not more than 6. The present specifications produce a dense well-bonded base course, which has proved very satisfactory and which can be maintained by dragging and with occasional calcium chloride treatments until the asphalt top is placed.

The 6-in. bituminous stabilized base course built in 1938 and 1939 was placed by a traveling plant that mixed crusher-run stone, subgrade soil as binder, and bituminous material. None of this experimental work was entirely satisfactory and all of it has been costly to maintain. The method tried does not give adequate control of the binder quality under varying subgrade conditions. The bituminous-stabilized base costs much more than the soil-stabilized bases now placed and is without any compensating advantage.

The first experience in simple bituminous treatment on about 50 miles of local stone base was not satisfactory because of the mica content of some of the stone. It was discovered that much of the local stone is hydrophilic and should not be used in bituminous treatments or mixtures. In some areas the use of limestone is now specified in the asphaltic-concrete top courses because of the hydrophilic characteristic in the other local rocks.

In early specifications provision was made for excavating rock and unfavorable material in the subgrade and backfilling with selected material reserved from the excavation. The selection of these places to be excavated and of the backfilling material was left to the judgment of the men on the job. The practice has been adopted of making a materials survey in advance of construction, and it is required that all earth subgrades are to be undercut and backfilled with soil material of A1, A2, or A3 classification. In rock cuts an evener course of stone fragments or selected granular material is now laid directly on the original rough cut. The new practice avoids the danger of water pockets and swelling of base that sometimes occurred under the earlier practice of fine grading with earth backfill over the rock cuts. The top layers of all fills are now constructed of A1, A2, or A3 soils.

In early work, earth fills were placed in 12-in. layers and were compacted by the construction equipment. Present specifications require test-controlled compaction of earth fills, and rolling of all fills, including rock fills. Layers in rock fills may be up to 24 in. in thickness.

Soil Compaction Experiments Point Toward Better Subgrades

(*Continued from page 35*)

seems evident that for a given moisture content there is a maximum strength that can be obtained, and regardless of further compactive effort applied, this maximum strength cannot be exceeded.

A point of importance is the fact that ultimate density and ultimate strength occur at essentially the same moisture content and at the same compactive effort.

The relative positions of the commonly prescribed tests for soil compaction are interesting to note. It is quite evident that the values of strength and density obtained by following the AASHO T-99-38 specifications of 25 blows per layer are low in comparison to those that may be reached through decrease in moisture and increase in compactive effort. Compaction specifications recommended by the California bearing ratio test are a step toward higher density and strength. However, they do not completely exhaust the possibilities of the soil. Tests based entirely upon strength are satisfactory, if the moisture content of the subgrade remains as it is in the initial compaction conditions. Proponents of strength tests have strongly advocated this consideration.

Summary

The experimental work on soil compaction that has been conducted in the laboratory of the Engineering Experiment Station, University of Utah, has shown that:

1. Existing methods of compaction control, such as AASHO T-99-38, California bearing ratio test, etc., although correct within the range employed, do not exhaust the density–bearing power possibilities for a given soil.

2. For a given soil, conditions of ultimate density (with correspondingly higher stability and bearing power) can be obtained, provided that the soil is compacted not only at an optimum moisture content, but also at an optimum compactive effort.

3. If the soil is compacted under conditions that provide this ultimate density, bearing power in the magnitude of six or seven times that which would normally be obtained will result. If adequate waterproofing methods (drainage, surface sealing, etc.) are followed, this greater bearing power can be used for design purposes.

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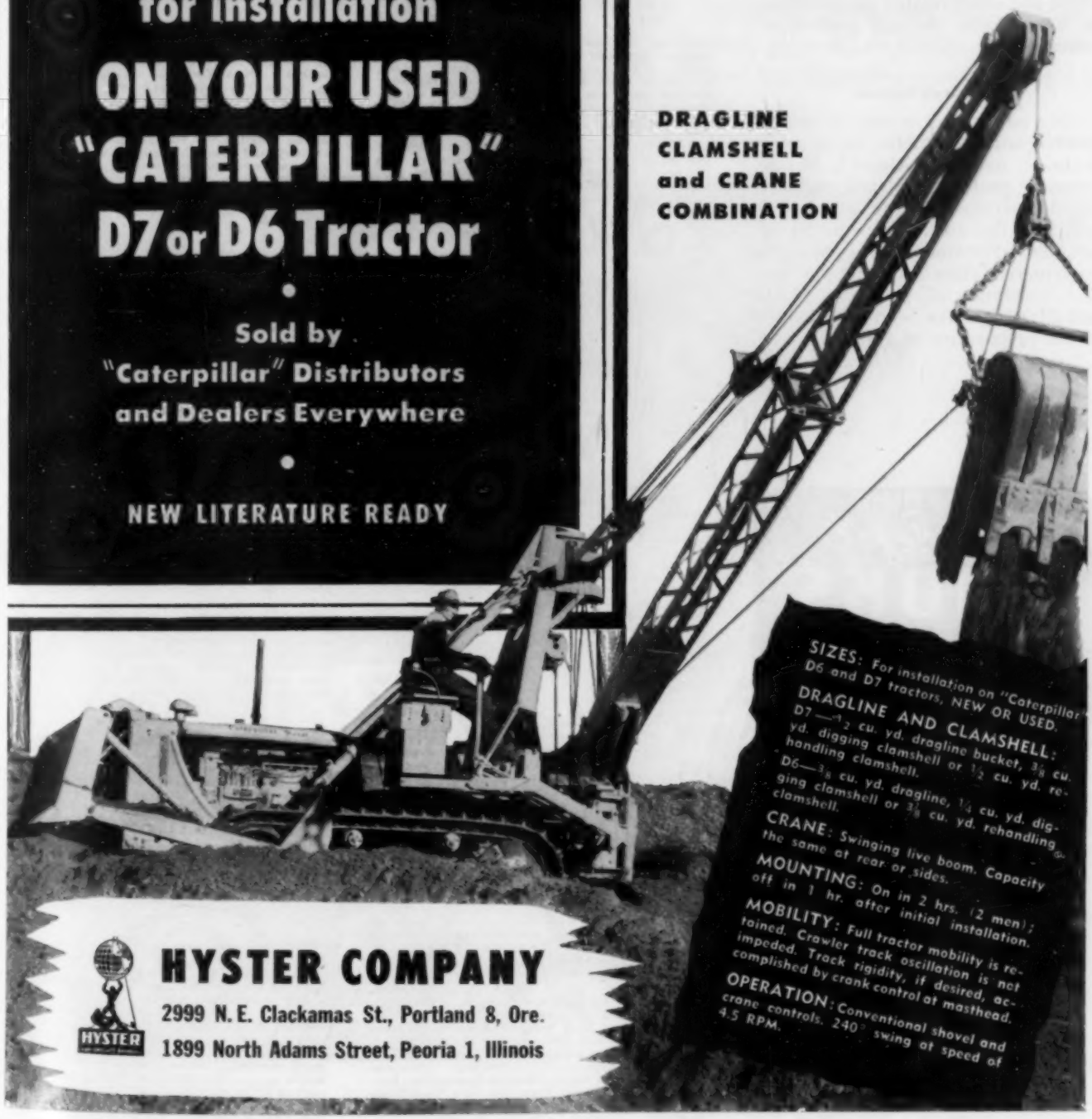

SIZES: For installation on "Caterpillar" D6 and D7 tractors, NEW OR USED.

DRAGLINE AND CLAMSHELL: D7—1½ cu. yd. dragline bucket, ⅜ cu. yd. digging clamshell or ½ cu. yd. rehandling clamshell.
D6—⅜ cu. yd. dragline, ¼ cu. yd. digging clamshell or ⅜ cu. yd. rehandling clamshell.

CRANE: Swinging live boom. Capacity the same at rear or sides.

MOUNTING: On in 2 hrs. (2 men); off in 1 hr. after initial installation.

MOBILITY: Full tractor mobility is retained. Crawler track oscillation is not impeded. Track rigidity, if desired, accomplished by crank control at masthead.

OPERATION: Conventional shovel and crane controls. 240° swing at speed of 4.5 RPM.

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At best, the experimental work has only scratched the surface of the relatively unexplored field of higher compactive effort. Information thus far obtained shows promise of having real value in combating the immediate problems of construction for greater wheel loads and in meeting the long-range economic consideration of high maintenance costs. However, adequate field control methods to define these newly determined conditions are yet to be developed. Also to be answered is the question of what modifications (if any) must be brought about in soil compaction equipment in order to reach ultimate density in the field. These and other related problems can be solved only through further research.

Acknowledgments

This paper is a report of experimental work conducted by a group of three: namely, Richard L. Sloane, associate professor of civil engineering, University of Utah; Ralph O. Hill and the author as student assistants. The timely suggestions, the constructive criticisms, and the general assistance of Professor Sloane and Mr. Hill have been very helpful in the preparation of this paper.

(THE) ANATOMY OF DEPRECIATION. By Luther Nash. Public Utilities Reports, Inc., Washington, D.C., 1947. 214 pp., 6 × 8¼ in., cloth. Management and engineers alike will profit from this comprehensive discussion of accounting for retirement or "depreciation" of public utility properties. The book goes far toward making clear to management, to regulatory officials, and to engineers, who are generally not accountants, the difficult problem of restoring, through a system of reserves, the capital cost of units of property whose replacement or retirement cannot properly be said to fall under operating expenses.

A.S.T.M. STANDARDS ON CONCRETE AND CONCRETE AGGREGATES. Prepared by A.S.T.M. Committee C-9; Specifications, Methods of Testing, Definitions. American Society for Testing Materials, Philadelphia (Pa.), 1947. 149 pp., illus., diagrs., tables, 9 × 6 in., paper, $2; to A.S.T.M. members, $1.50. Of the 53 standards presented in this useful compilation, some 15 each are devoted to test methods for concrete and for concrete aggregates. The remaining items are standard and tentative specifications for concrete, aggregates, natural and portland cements, concrete curing materials, concrete reinforcement, expansion joint fillers, and sieves for testing purposes. The main arrangement is classified, with an additional list of the contents in numerical sequence.

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

CHEMISTRY OF PORTLAND CEMENT. By R. H. Bogue. Reinhold Publishing Corp., New York, 1947. 572 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $10. This extensive treatise is divided into three main parts: Part I, on the chemistry of clinker formation, is concerned chiefly with high-temperature reactions in the dry state; Part II, on the chemistry of cement utilization, deals with reactions between cement and water or solutions; Part III, dealing with the phase equilibria of the cement systems, provides information on a subject with which both of the other fields of study are intimately concerned.

DICCIONARIO INGLES-ESPANOL DE TERMINOS RELACIONADOS CON LA INGENIERIA DE CAMINOS. By Francisco Gaston, M. ASCE. Sociedad Cubana de Ingenieros, Havana (Avenida de Belgica No. 258), 1946. 170 pp., 9¼×6 in., paper, $2. This English-Spanish dictionary of road-engineering terms, originally presented as a paper before the National Engineering Congress of Cuba in 1945, will be useful to engineers working in Latin-American countries. There is an index of Spanish technical terms.

DWELLING HOUSE CONSTRUCTION. By A. G. H. Dietz. D. Van Nostrand Co., New York, 1946. 371 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $6. A comprehensive guide to frame-building construction, this book explains in detail all the steps involved in the complete erection of a house, from the original inspection of the site to the final costs of paint. Excavation and soils, foundations and footing design, framing details, roofing and flashing, windows and doors, lathing and insulation, etc., are described with numerous illustrative sketches and photographs supplementing the exact directions. Plumbing, heating, and wiring and allied subjects are omitted as being separate specialized fields.

ELEMENTS OF HYDRAULIC ENGINEERING. By D. S. Ellis. D. Van Nostrand Company, New York, 1947. 277 pp., diagrs., charts, tables, 9¼ × 6 in., cloth, $3.50. Chapters I to X present a concise treatment of the basic ideas and methods of hydraulics, from hydrostatics to the dynamic effects of fluids, customary for a first course in the subject. The remainder of the book is concerned with the operating characteristics of the commoner hydraulic machines, such as pumps, water wheels and fans, and with such special topics as water hammer, waves and surges in open channels.

ENGINEERING ECONOMICS AND PRACTICE, including Solutions to Problems in Professional Engineer Examinations, New York State. By M. J. Steinberg and W. Glendinning. Apply W. Glendinning, Bayside, N.Y. (5123 Bell Blvd.), 1947. 101 pp., diagrs., charts, tables, 11½ × 8½ in., paper, $3. This book covers the basic principles of engineering economics and practice. The principles have been reduced to a formula basis with each of the terms clearly defined. Each chapter includes problems of a practical nature that illustrate the principles involved. Questions and solutions to the problems in Engineering Economics and Practice from the New York State Professional Engineering examinations are an important supplement to the text material.

FALK'S GRAPHICAL SOLUTIONS TO 100,000 PRACTICAL PROBLEMS, prepared and edited by T. H. Falk. Columbia Graphs, Columbia, Connecticut, 1946. 402 pp., charts, 9½×6 in., cloth, $6. This volume contains 400 worked-out graphs covering standard calculations for a large variety of practical problems in mechanics, hydraulics, electricity, physics, chemistry, shop work, construction, trigonometry, weights, and measures. The graphs are all of the simple type in which the intersection of two lines, established by the known quantities, provides the direct answer.

GERMAN RESEARCH IN WORLD WAR II. By L. E. Simon. John Wiley & Sons, New York; Chapman & Hall, London, Ltd., 1947. 218 pp., illus., diagrs., tables, 9¼×6 in., cloth, $4. The author, one of a group of scientists commissioned to visit Germany immediately after the surrender, presents an analysis of the organizations engaged in the German war research. In connection with this, he surveys their important results in the fields of interior, exterior and terminal ballistics, fire control, instruments and measurement techniques, and aerodynamics. Rockets, sonic devices, and other unusual types of weapons are described. The author concludes with a chapter of comments and criticism applicable to research in general.

GUIDE TO THE LITERATURE OF MATHEMATICS AND PHYSICS, including Related Works on Engineering Science. By N. G. Parke III. McGraw-Hill Book Co., New York and London, 1947. 203 pp., tables, 9¼×6 in., cloth, $6. A detailed bibliography of world literature in the field of mathematics and physics, and related aspects of engineering science, is presented in this volume. Containing about 1,800 entries, the book provides scientists and research engineers with a valuable key to authoritative information, on a wide range of subjects from algebra to atomic and nuclear physics. The early part of the book contains a helpful section on reading, reference, and library techniques.

SAUDI ARABIA WITH AN ACCOUNT OF THE DEVELOPMENT OF ITS NATURAL RESOURCES. By K. S. Twitchell. Princeton University Press, Princeton, N.J., 1947. 192 pp., illus., maps, tables, 8×5 in., cloth, $2.50. The author, an American mining engineer, has given a straightforward account of the emergence of a little-known nation into the modern world. First-hand information is given on the geography and climate, water supply, and transportation facilities. Lastly, the author considers the position of Saudi Arabia in present-day world economy, covering its contact with the West, its valuable oil and mine resources, and future possibilities for commerce and agriculture.

SEWERAGE AND SEWAGE TREATMENT, 6 ed. By H. E. Babbitt. John Wiley & Sons, New York; Chapman & Hall, London, 1947. 692 pp., illus., diagrs., charts, tables, 8¼ × 5½ in., cloth, $6.50. In the new edition of this standard text stress has been laid more on problems of design, methods of treatment, and the operation of plants than on construction. Its comprehensive coverage of all phases of the subject has been widened by the addition of material on high-rate filters, contact aerators, and other changes in practice. The most extensive revision has been in the material on runoff determinations and the hydraulics of sewers. This new edition also contains some 45 pages of problems and literature references.

SIX-PLACE TABLES, with Explanatory Notes by E. S. Allen, ed. McGraw-Hill Book Co., New York and London, 1947. 232 pp., tables, 7¼×4½ in., cloth, $2.50. This standard reference book presents a selection of tables of squares, cubes, square and cube roots, fifth roots and powers, circumferences and areas of circles, common logarithms of numbers and of the trigonometric functions, natural trigonometric functions, natural logarithms, exponential and hyperbolic functions, and integrals. An introductory section explains briefly the theory of logarithms and the use of logarithmic and certain other tables.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS. Proceedings Vol. IV, No. 1. Edited by C. Lipson and W. M. Murray; published and distributed by Addison-Wesley Press, Inc., Kendall Square Cambridge, Mass., 1946. 129 pp., illus., diagrs., charts, tables, 11¼×8¼ in., cloth, $6. The current volume of this semiannual publication contains twelve papers by specialists. Topics covered include strain rosette analyses and computations, stress studies of various mechanical structures, brittle lacquer indications of residual stresses, impact on prismatical bars, and the pressure of plastic concrete in forms. A list of members of the Society is included.

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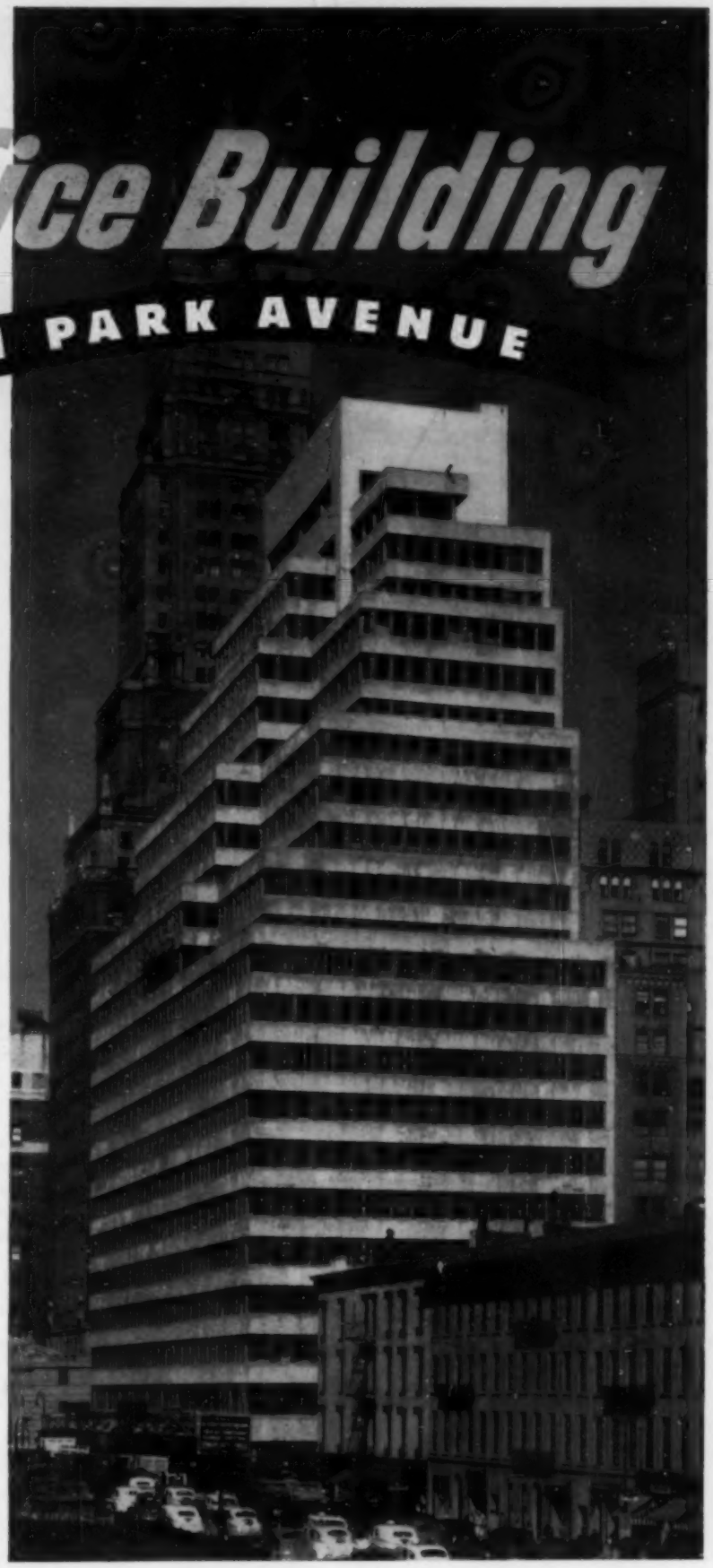

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SMARIGA, JULIAN EMIL (Assoc. M. '47) Structural Engr., Div. of Hospital Facilities, U.S. Public Health Service, Office of Technical Services (Res., 1407 Newton St., N.E.), Washington 17, D.C.

SPAEDER, HAROLD JOHN (Assoc. M. '46) Engr., The Dorr Co., 221 North La Salle, St. Chicago 1, Ill.

STANGER, ROY ARMOUR (Assoc. M. '47) 126 Ark-Mo Highway, North Little Rock, Ark.

TREGONIS, VERNE MILTON (Assoc. M. '47) Lt. Comdr., CEC USN, Public Works Dept., Naval Ammunition Depot, Earle, N.J.

TURNER, HAROLD EUGENE (Jun. '46) Engr., Accountant, Chicago & North Western Ry., 400 West Madison St. (Res., 311 North Waller Ave.), Chicago 44, Ill.

WAGER-SMITH, DAVID RICHARD WILLSON (Assoc. M. '47) Engr., Box 528, Silver City, N.Mex.

WALLACE, WALES WELLINGTON (Assoc. M. '47) Res. Engr., Polk, Powell and Hendon, Engrs., 518 Deadrick St., Nashville, Tenn.

WARD, ELMER MERVIN (M. '47) Engr. of Maintenance and Equipment, National Research Council, Highway Research Board, 2101 Constitution Ave., Washington 25, D.C.

WEBER, ALFRED HENRY (Assoc. M. '47) Constr. Engr., Tennessee Valley Authority, Hales Bar Dam, Mail Room "A" (Res., 123 Shawnee Trail), Chattanooga, Tenn.

WEISZ, CHARLES PHILIP (Jun. '46) With Hazelet & Erdal, Cons. Engrs., 1518 Heyburn Bldg. (Res., 222 Kingston Ave.), Louisville, Ky.

WERNTZ, CHARLES GARNER (Assoc. M. '47) Engr., American Bitumuls Co., 1150 Connecticut Ave., N.W., Washington, D.C. (Res., 26 Thompson St., Annapolis, Md.)

WETHERELL, DWIGHT NELSON (M. '47) Chf. Structural Engr., Texas Div., Dow Chemical Co. (Res., 1623 West Broad St.), Freeport, Tex.

WILDE, STAFFORD HAROLD (Assoc. M. '47) Gen. Mgr., W. S. Bellows Constr. Corp., P.O. Box 2132, Houston 1, Tex.

TOTAL MEMBERSHIP AS OF JUNE 9, 1947

Members	6,656
Associate Members	8,596
Corporate Members	15,252
Honorary Members	39
Juniors	6,471
Affiliates	75
Fellows	1
Total	21,838
(June 10, 1946	21,383)

WITHEY, MORTON OWEN (M. '47) Dean, College of Eng., Univ. of Wisconsin, Mech. Eng. Bldg., Madison 5, Wis.

WOOD, STANLEY (M. '47) Engr., The Pitometer Co., Inc., 50 Church St., New York 7, N.Y.

WOOD, WILLIAM EARL (Assoc. M. '47) Engr., War Dept., Corps of Engrs., Santa Fe Bldg. (Res., 4828 Q½), Galveston, Tex.

Membership Transfers

ANDERSON, EDWARD WALTER (Jun. '37; Assoc. M. '47) Engr. in Designing Dept., American Bridge Co., 71 Broadway, New York, N.Y. (Res., 2064 Newark Ave., Westfield, N.J.)

BACLINI, DAVID (Jun. '45; Assoc. M. '47) Structural Engr., Anthony M. Meyerstein, Inc., 66 Court St. (Res., 1241 Voorhies Ave.), Brooklyn 29, N.Y.

BURKS, WILLIAM SPRATLEY, JR. (Jun. '34; Assoc. M. '47) Structural Engr., U.S. Engr. Office, Mobile, Ala.

BURNSON, BLAIR IRVING (Jun. '34; Assoc. M. '46) Superv. San. Engr., East Bay Municipal Utility Dist., P.O. Box 720 (Res., 3408 Richmond Blvd.), Oakland 11, Calif.

CALLAHAN, CLARENCE ANDREW (Jun. '43; Assoc. M. '47) Asst. Gen. Supt., Williams Brothers Co., Apartado 593, Maracaibo, Venezuela, S.A.

CAMP, CECIL SIDNEY (Jun. '31; Assoc. M. '39; M. '47) Associate Prof., Hydr. and San. Eng., Univ. of Tennessee, 117 Ferris Hall, Knoxville, Tenn.

COLEMAN, PAUL HENDERSON (Jun. '38; Assoc. M. '47) Res. Engr., State Highway Dept., Box 388, Cooper, Tex.

CURRY, THOMAS SHERROD, JR. (Jun. '40; Assoc. M. '47) Engr., International Boundary & Water Comm., U.S. Section, 627 First National Bank Bldg. (Res., 3413 Nashville St.), El Paso, Tex.

DAVENPORT, GEORGE FOLLIN, JR. (Jun. '42; Assoc. M. '47) Civ. Engr., Sun Oil Co., Room 1006, San Jacinto Bldg. (Res., 680 Elgie St.), Beaumont, Tex.

DETWEILER, JOHN CONNETT (Assoc. M. '35; M. '47) Water Engr., Metropolitan Utilities Dist., Utilities Bldg., 18th and Harney Sts. (Res., 2870 Howell St.), Omaha, Nebr.

DOBBIN, JOHN RALPH (Jun. '37; Assoc. M. '47) Chf., Estimates and Schedules Branch, Constr. Div., Corps of Engrs., Kansas City Dist., 10 East 17th St. (Res., 1820 East 70th St.), Kansas City 5, Mo.

EXUM, JAMES POWERS (Assoc. M. '28; M. '47) Bridge Engr., State Highway Dept. (Res., 704 Texas Ave.), Austin, Tex.

FIELDS, RICHARD CLORE (Jun. '41; Assoc. M. '47) Structural Designer, Howard, Needles, Tammen & Bergendoff, 921 Walnut St., Kansas City (Res., 505 South Green St., Lee's Summit), Mo.

FLANDERS, ROYAL CALL, JR. (Jun. '45; Assoc. M. '47) Structural Designer, Fay, Spofford & Thorndike, 11 Beacon St., Boston (Res., Concord Rd., South Lincoln), Mass.

GUDEN, RICHARD MORTIMER (Jun. '40; Assoc. M. '47) Civ. Engr., U.S. Naval Shipyard, New York (Res., 27 Watts Place, Lynbrook), N.Y.

HAHN, ROBERT LEROY (Jun. '32; Assoc. M. '41; M. '47) Chf. Structural Engr., Jones-Hettelsater Constr. Co., 1012 Baltimore, Kansas City 6, Mo.

HALL, WILLIAM HARVEY (Jun. '40; Assoc. M. '47) Civ. Engr., Bldg. Supervision Dept., Oklahoma Agr. and Mech. College (Res., Route 2), Stillwater, Okla.

HARRIS, ROY MONTE (Assoc. M. '32; M. '47) Chf. San. Engr., Creole Petroleum Corp., Apartado 889, Caracas, Venezuela, South America.

HATFIELD, WILLIAM PAUL (Assoc. M. '31; M. '47) Asst. to Div. Engr., Reconstruction Finance Corp., 407 North Eighth St. (Res., 5556 Clemens Ave.), St. Louis 12, Mo.

HOBBS, MERRILL HOPKINS (Assoc. M. '39; M. '46) Pres., Hobbs & Lee, 511 Park Ave., Baltimore (Res., 1529 West Falkland Lane, Silver Spring), Md.

HOFFBERG, WILLIAM ARNOLD (Jun. '27; Assoc. M. '36; M. '47) Cons. Engr., 67 West 44th St. (Res., 1615 Walton Ave.), New York 52, N.Y.

IORNS, WILLIAM VAUGHN (Jun. '30; Assoc. M. '39; M. '47) Project Engr., U.S. Geological Survey, Box 413, Logan, Utah.

JASKAR, ADE EUGENE (Jun. '42; Assoc. M. '47) Asst. Dist. Geologist, U.S. Engr. Office, 1400 Textile Tower (Res., 2514 Hinds St.), Seattle 44, Wash.

JOHNSON, JOE WILLIAM (Jun. '35; Assoc. M. '39; M. '47) Associate Prof. of Mechanical Eng., Univ. of Calif., 227 Mech. Bldg., Berkeley, Calif.

JOHNSON, TOM ROYSE (Jun. '31; Assoc. M. '38; M. '47) Public Works Officer, USN, U.S. Naval Station, Tacoma 2, Wash.

KELKER, JAMES JOSEPH ARTHUR (Jun. '30; Assoc. M. '33; M. '47) Div. Engr., The Ohio Oil Co. (Res., 232 East Herndon St.), Shreveport 70, La.

KINGSTON, JOSEPH ROY, JR. (Jun. '40; Assoc. M. '47) (Burke & Kingston), P.O. Box 352, New Iberia, La.

KOCH, ALVA ERNST (Jun. '39; Assoc. M. '47) Graduate Student, Civ. Eng. Dept., Texas A. & M. College (Res., Box 4266), College Station, Tex.

KUHL, LEWIS CHARLES, JR. (Assoc. M. '36; M. '47) Engr., Turner Constr. Co., 420 Lexington Ave., New York, N.Y. (Res., Wild Cat Rd., Darien, Conn.)

LARSON, LINNE CLARENCE (Jun. '20; Assoc. M. '30; M. '47) (Taylor & Taylor, Cons. Engrs.), 725 South Spring St., Los Angeles, Calif.

MANN, GEORGE BOLEY (Jun. '42; Assoc. M. '47) 468 Bel Air Ave., Aberdeen, Md.

MARX, GEORGE WASHINGTON (Assoc. M. '45; M. '47) Director, Div. of San. Eng., State Dept. of Health, Capitol Bldg. (Res., 1610 West Vernoa), Phoenix, Ariz.

MCLEA, DUNCAN KENNEDY (Jun. '38; Assoc. M. '47) Inspecting Engr., National Road Board, P.O. Box 415, Pretoria, Union of South Africa.

MESSINGER, HENRY MCCLURE (Jun. '43; Assoc. M. '47) Registered Surveyor, 401 Jackson, Bastrop, La.

MINER, CLARENCE CROSIAR (Assoc. M. '36; M. '47) Civ. Engr., U.S. Bureau of Reclamation, P.O. Box 605, St. George, Utah.

MITCHELL, RICHARD RAY (Assoc. M. '20; M. '47) Senior Highway Engr., U.S. Public Rouds Administration, Federal Bldg. (Res., 2757 Harrison Blvd.), Ogden, Utah.

MORSE, REED FRANKLIN (Assoc. M. '35; M. '47) Prof., Civ. Eng. Dept., Kansas State College, Manhattan, Kans.

OMSTED, HARALD (Assoc. M. '34; M. '47) Senior Structural Engr., J. M. Montgomery & Co., Inc., 306 West Third St. (Res., 5357 Brynhurst Ave.), Los Angeles 43, Calif.

ONDERDONK, ARTHUR BRUCE JOSEPH (Jun. '42; Assoc. M. '46) First Asst. Engr., F. P. Close, Civ. and Cons. Engr., 49 Pearl St., Hartford (Res., R.D. 1, Box 207, Glastonbury), Conn.

ORTIZ, JOSE PULIDO (Assoc. M. '39; M. '47) Director Gen. de Obras Maritimas, Secretariat of Marina, Mazatlan, Sinaloa State (Res., Ave. Insurgentes 1335, Mixcoac), D.F. Mexico.

PAGELS, GEORGE, JR. (Jun. '34; Assoc. M. '47) Vice-Pres., Penetryn System, Inc., P.O. Box 1068, Albany, N.Y. (Res., 1647 West 99th St., Chicago 43, Ill.)

PAINTER, CARL ELLIOTT (Assoc. M. '20; M. '47) Vice-Pres. & Cons. Engr., Waterworks Equipment Co., 149 West Second South (Res., 1328 Michigan Ave.), Salt Lake City, Utah.

PORGES, RALPH (Jun. '36; Assoc. M. '47) San. Engr., U.S. Public Health Service, 1152 U.S. Appraisers Bldg., San Francisco 11, Calif.

PORTEUS, JOHN HORTON (Assoc. M. '39; M. '47) Structural Engr., Jackson & Moreland, 31 St. James Ave., Boston (Res., Upwey Rd., Wellesley Hills 82), Mass.

RAIT, ROBERT ALEXANDER (Assoc. M. '40; M. '47) Constr. Engr., Humble Oil & Refining Co. (Res., 4124 Marquette), Houston 5, Tex.

REINHARDT, CHARLES ORVILLE (Jun. '38; Assoc. M. '47) Comdr., CEC., USN, 1604 West University Ave., Champaign, Ill.

ROBERTSON, ROBERT EMMETT, JR. (Assoc. M. '42; M. '47) (Saxe, Williar & Robertson), 130 West Hamilton St. (Res., 1406 Bolton St.), Baltimore 17, Md.

ROBBINS, EDWIN GUY (Jun. '37; Assoc. M. '47) Soil-Cement Field Engr., Portland Cement Assn., 33 West Grand Ave. (Res., 9845 South Winchester Ave.), Chicago 43, Ill.

ROUNTREE, JACK ROBERTS (Jun. '37; Assoc. M. '47) Civ. Engr., Tennessee Valley Authority, Wilson Dam (Res., 443 North Pine St., Florence), Ala.

SCHUCKEL, WILLIAM BOULTON (Assoc. M. '42; M. '46) Civ. Engr., Voorkees, Walker, Foley & Smith, 101 Park Ave., New York, N.Y. (Res., 129 Kenilworth Rd., Mountain Lakes, N.J.)

SCISSON, SIDNEY EUGENE (Jun. '41; Assoc. M. '47) Engr., Pate Eng. Co., 306 Richard Bldg. (Res., 1731½ East 15th), Tulsa, Okla.

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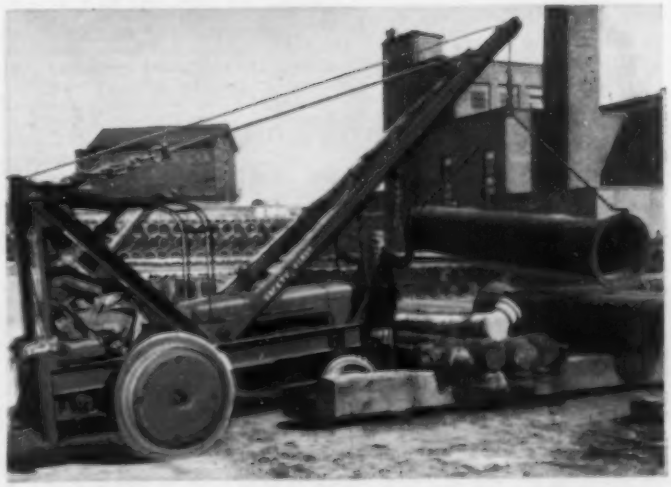

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SILVER, EDWARD CHARLES (Jun. '42; Assoc. M. '47) Asst. Supt., Hartley, Fraser Mines, Oliver Iron Mining Co., Hibbing (Res., 129 Fraser, Chisholm), Minn.

SOUTHERLAND, HENRY DELEON, JR. (Jun. '37; Assoc. M. '47) Student, Columbia Univ., New York, N.Y. (Res., 1901 Nineteenth St., N.W., Washington, D.C.)

SPEERT, JULIUS LOUIS (Jun. '27; Assoc. M. '38; M. '47) Topographic Engr., U.S. Geological Survey, 6213 FWA Bldg., Washington 25, D.C.

STAUDER, ARTHUR OSCAR (Assoc. M. '31; M. '47) Bridge Engr., Div. of Waterways, State of Illinois, 58 North Chicago St., Joliet (Res., 6449 North Seeley Ave., Chicago), Ill.

STICKLE, SAMUEL DARE (Assoc. M. '38; M. '47) Engr., Great Lakes Dredge & Dock Co., 17 Battery Place, New York (Res., 26 Harbor View Court, Staten Island 1), N.Y.

SWITZER, ALFRED IVAN (Jun. '39; Assoc. M. '47) Asst. Chf., Civ. Works Branch, Corps. of Engrs., War Dept., 751 South Figueroa St., Los Angeles (Res., 530 Thompson Drive, Pasadena 6), Calif.

THOMPSON, JOSEPHINE GLADYS (Miss) (Jun. '41; Assoc. M. '47) 1174½ East 42d St., Brooklyn 10, N.Y.

VILLEMONTE, JAMES RICHARD (Jun. '41; Assoc. M. '47), Research Asst., Hydraulics & San. Laboratory, Univ. of Wisconsin, Madison, Wis.

WARREN, PAUL EDWARD (Jun. '32; Assoc. M. '47) Associate Highway Engr., U.S. Public Roads Administration, 254 Custom House, Denver (Res., 3187 Tenth St., Boulder), Colo.

WEGMAN, LEONARD SAMUEL (Jun. '37; Assoc. M. '47) (Leonard S. Wegman & Co.), 9 East 45th St., New York 17, N.Y.

WILSON, MILTON THEURER (Assoc. M. '33; M. '47) Dist. Engr., U.S. Geological Survey, 303 Federal Bldg., Salt Lake City, Utah.

WINICK, CHARLES BORIS (Assoc. M. '35; M. '47) Pres., Great Atlantic Constr. Corp., 711 Eighth Ave., New York 19, N.Y.

Reinstatements

BECK, RONALD MACKENZIE, Assoc. M., Dist. Constr. Engr., State Highway Dept., 216 De Witt Ave., Belleville, N.J., reinstated May 13, 1947.

CARMICHAEL, HENRY ST. GEORGE TUCKER, JR., M., Chf. Engr., Drake-Utah-Grove, P.O. Box A, Sausalito, Calif., readmitted Mar. 12, 1947.

DEWART, DONALD MACLEAN, Jun., 2474 Lake View Ave., Chicago 14, Ill., reinstated May 28, 1947.

HIPP, CHARLES LEO, Assoc. M., Office Engr., Corps of Engrs., Omaha Dist. Office, 1709 Jackson St. (Res., 2421 Vane St.), Omaha 11, Nebr., readmitted May 19, 1947.

JENSON, THEODORE BRUCE, Assoc. M., 3959 Forty-second Ave. South, Minneapolis, Minn., reinstated May 13, 1947.

MORRIS, JOHN RYAN (M. '47) Head of Structural and Civ. Eng. Dept., A. M. Kinney, Inc., Cons. Engrs., Room 1211 Enquirer Bldg., Cincinnati, Ohio (Res., 1169 Morgan Court, Park Hills, Covington, Ky.), readmitted May 19, 1947.

MORTENSON, ERNEST DAWSON, M., Asst. City Planning Engr., City Plan Dept., 200 Orange St., New Haven (Res., 100 High St., East Haven), Conn., readmitted Mar. 12, 1947.

PHIPPS, FRANK WILLIAM, Assoc. M., Associate Engr., Army Engrs. (Res., 8020 Roosevelt Way), Seattle 5, Wash., reinstated June 3, 1947.

SENIOR, RICHARD LORENZO, Assoc. M., Constr. and Project Mgr., American Community Builders, Inc., 105 West Monroe St., Chicago, Ill., reinstated May 13, 1947.

SHERWOOD, NIAL, Assoc. M., Civ. Engr., 19 Chestnut St., Liberty, N.Y., reinstated May 28, 1947.

STEFFENSEN, ROBERT WILLIAM, Jun., With Constr. Dept., Ohio Edison Co. (Res., Room 1415 Y.M.C.A.), Akron 8, Ohio, reinstated May 28, 1947.

SUTTON, SHERWOOD ADELBERT, Jun., 1158 West Church St., Elmira, N.Y., reinstated June 4, 1947.

TOWNER, JAMES MADSEN, Jun., Sales Engr., U.S. Gypsum Co., P.O. Box 8085 (Res., 3514 Mt. Pleasant), Dallas 11, Tex., readmitted Feb. 10, 1947.

UNDERHILL, ALPHEUS FINCH, Assoc. M., Chf. Engr., Henry W. Streeter Corp., Gen. Contrs., 103 East Woodlawn Ave. (Res., 114 Durland Ave.), Elmira, N.Y., reinstated May 28, 1947.

WILLIAMS, STANLEY NEALE, Assoc. M., Engr., Clyde Potts, Cons. Engr., 30 Church St., New York, N.Y. (Res., 117 Grace St., Roselle, N.J.), reinstated May 26, 1947.

Resignations

BEAR, HERBERT STANLEY, M., 1250 Sixth Ave., San Diego 12, Calif., resigned Apr. 29, 1947.

BROWN, GEORGE FRANK, Assoc. M., 1177 Tremaine Ave., Los Angeles, Calif., resigned May 14, 1947.

BULKLEY, ROBERT ALDRICH, Jun., 424 Blake St., Wray, Colo., resigned May 12, 1947.

BURNS, JOHN ALLEN, Jun., Center, Colo., resigned May 13, 1947.

FISH, FRANKLIN WAKEFIELD, JR., Assoc. M., 747 East Kingsley Ave., Pomona, Calif., resigned May 27, 1947.

JENNINGS, JEREMIAH EDMUND BOWDEN, Jun., National Building Research Institute, Private Bag 180, Pretoria, South Africa, resigned May 28, 1947.

HAND, HOWARD WILLIS, JR., Jun., P.O. Box 6118, Portland, Ore., resigned May 22, 1947.

MORGAN, JACK CHARLES, Jun., 509 Woodland Rd., W. Allenhurst, N.J., resigned May 21, 1947.

SCHEIRER, MERRILL KLECKNER, Assoc. M., 528 Maple Ave., Trenton 8, N.J., resigned May 13, 1947.

SELBY, GARLAND FERD, Assoc. M., 617½ Commercial, Emporia, Kans., resigned May 22, 1947.

TEUTSCH, KURT, Jun., 145 Upland Road, Cambridge 40, Mass., resigned May 13, 1947.

APPLICATIONS FOR ADMISSION OR TRANSFER

July 1, 1947 — Number 7

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

APPLYING FOR MEMBER

ARNTZEN, JOHN CHRISTIAN (Age 46) Chf. Engr., Melrose Park Plant, Mississippi Valley Structural Steel Co., Melrose Park, Ill.

ASHTON, GEORGE CRAPSER (Assoc. M.) (Age 45) Chf. Draftsman, Bridge Dept., C.B. & Q.R.R., Chicago, Ill.

BAXTER, DHUNJIBHOY CURSETJEE (Age 43) Project Officer, Central Tech. Power Board, Govt. of India, Simla, India.

BENSON, MONS HERMAN (Assoc. M.) (Age 42) Engr., Regional Office, U.S. Bureau of Reclamation, Boise, Idaho.

BLAIR, ROBERT COLLYER (Assoc. M.) (Age 46) Asst. to Pres., Inter-American Constr. Corp., New York City.

BLOMGREN, WALTER EDWARD (Age 55) Regional Engr., Region 7, Bureau of Reclamation, Denver, Colo.

BOSWELL, JOSEPH IRA (Age 37) Engr. P-5, Asst. Chf., River Constr. Branch, War Dept., Engr. Dist., Vicksburg, Miss.

BRITE, HECTOR LEIGH (Age 49) Industrial Specialist, Office of Housing Expediter, Washington, D.C.

BROOKS, RALPH SIMPSON (Age 47) Private practice Consulting and general engineering, Monrovia, Calif.

BROWN, ASA DARRELL, SR. (Age 46) Asst. Engr. in Charge, Jacksonville Area Field Activities Sec., Corps of Engrs., Jacksonville Dist., Mayport, Fla.

BYERS, JAMES ELLIOTT (Assoc. M.) (Age 54) Chf., Bldg. Branch, Business Div., Los Angeles School Dist., Los Angeles, Calif.

CHATTEY, JOHN KARL (Age 40) San. Engr., Inst. of Inter-American Affairs; Cons. Engr. to SCISP, Servicio Cooperative Interamericano de Salud Publica, Guatemala City, Guatemala.

CLARK, LLOYD KIMBALL (Age 38) Project Mgr., Association of American R.Rs., Baltimore, Md.

CLARKE, HERBERT RENTOUL (Age 64) Chf. Engr., Burlington Lines, Chicago, Ill.

CLOGSTON, PERLEY WALTER (Assoc. M.) (Age 47) Constr. Supt., National Housing Authority, Washington, D.C.

CONRAD, HARRY LESTER (Assoc. M.) (Age 58) Pres. & Chf. Engr., The Christman Co., Lansing, Mich.

CROCKETT, EDWARD ST. LAWRENCE (Assoc. M.) (Age 48) Res. Engr., Ebasco Services, Inc., Jackson, Miss.

CRUZ, MAMERTO (Assoc. M.) (Age 58) Chf. Engr., Manila R.R. Co., Manila, P.I.

DAVIS, DONALD CARTER (Assoc. M.) (Age 45) City Engr. and Mgr. of Public Works, Turlock, Calif.

DIXON, JOHN WESLEY (Age 42) Director, Branch of Project Planning, Bureau of Reclamation, Washington, D.C.

DUCHARME, JEAN MARC (Assoc. M.) (Age 36) Engr. of Design and Member of Board of Directors, Crandall Dry Dock Engrs., Inc., Cambridge, Mass.

ECKLER, ERNEST HAVELOCK, JR. (Age 41) Engr. P-4, War Dept., Mississippi River Comm., Vicksburg, Miss.

EKAMBARAM, KOLIPAKKAM VENKATESA (Age 40) Superintending Engr., Madras (India) Public

(*Continued on page 90*)

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(*Continued from page 88*)

Works Dept.; on deputation to United States, Bureau of Reclamation, Denver, Colo.

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FALTUS, FRANTISEK (Age 46) Prof., Dept. of Civ. Eng., The Technical Univ. of Praha, Praha XIX, Czechoslovakia.

FARRELL, JOSEPH ROMULUS (Assoc. M.) (Age 51) Pres., Joseph R. Farrell, Inc., Philadelphia, Pa.

FIELDER, WALTER GEORGE (Age 40) Civ. and Hydr. Engr., Central New York Power Corp., Syracuse, N.Y.

FLETCHER, RAYMOND FRANCIS (Age 46) Civ. Engr., E. I. du Pont de Nemours & Co., Wilmington, Del.

GATEWOOD, JOSEPH STRONG (Assoc. M.) (Age 48) Hydr. Engr. P-4, U.S. Geological Survey, Tucson, Ariz.

GEER, ELIHU (Age 45) Asst. Prof. of Civ. Eng., Univ. of Detroit, Detroit, Mich.

GIBSON, RODNEY EARNEST (Age 41) City Planning Engr., Omaha, Nebr.

GOLDEN, LUKE PATRICK (Age 44) Lt.-Comdr., CEC, U.S. Navy, San Francisco, Calif.

GONGORA PAREJA, ENRIQUE (Assoc. M.) (Age 48) Director (Dean), National School of Engrs., Miraflores (Lima), Peru, S.A.

GOSWAMI, SHEKHARENDU MOHAN (Age 40) Res. Engr., Messrs. Oriental Constr. Corporation, Ltd., Calcutta, India.

GRAHAM, ROLAND RUSSELL (Assoc. M.) (Age 57) Div. Engr., American Bridge Co., New York City.

HASBROUCK, ROBERT RALSTON (Age 59) Chief, Eng. Branch, Office of Real Property Disposal, Portland, Ore.

HAWKINS, JOSEPH WASHBURN (Assoc. M.) (Age 64) Private practice, Sebring, Fla.

HELRICH, CARL SANFRID (Age 52) With John A. Johnson Contr. Corp., Oak Ridge, Tenn.

HILLER, VERNON THOMAS (Assoc. M.) (Age 39) Asst. Civ. Engr., Dept. of Public Works, Detroit, Mich.

HOKE, JOHN BOYD (Assoc. M.) (Age 48) Secy. and Treas., Potomac Constr. Co.; member of firms, Asphalt Products Co., and Skelly & Hoke, Martinsburg, W.Va.

HOLMBERG, HELMER HERBERT (Age 43) Chf. Engr., Load Transfer Devices, Inc., Chicago, Ill.; address, Moberly, Mo.

JACOBS, SAMUEL (Age 36) Owner, Adirondack Constr. Co., Glens Falls, N.Y.

JADHAV, BALVANTRAO LAXMANRAO (Age 44) Circle Engr., Drainage Circle, Nagpur Improvement Trust, Nagpur, C.P., India.

KEESE, OLIVER DE LA VERGNE (Assoc. M.) (Age 54) Div. Engr., Office of County Surveyor and County Engr., Los Angeles County, Calif.

KENNEDY, DANIEL (Assoc. M.) (Age 47) Chf., Operations & Planning Staff, Army Map Services, and Chf. Topographic Engr., Washington, D.C.

KENNEDY, ROBERT LOUIS (Age 38) Designer, Illinois Central R. R., Chicago, Ill.

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KOCH, ALBERT ARTHUR (Age 37) Civ. Engr., Arabian American Oil Co., Pasadena, Calif.

LOMMEL, GEORGE LAWRENCE (Age 58) Senior Constr. Engr. (FPHA), Washington, D.C.

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MATTERN, EDWIN KAUFFMAN (Age 38) Partner, Cons. Civ. Engr., Mattern & Mattern, Engrs., Roanoke, Va.

MEEK, ROBERT LEE (Age 44) With Moore & Owen, Indianapolis, Ind.

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QUIMBY, PAUL JAY (Assoc. M.) (Age 49) Senior Designer, Bethlehem Steel Co., Bethlehem, Pa.

REDD, CARL LEITNER (Age 46) Designer and Office Mgr., with Van Resselave P. Saxe, Cons. Engr., Cockeysville, Md.

REIDY, PETER JOSEPH (Assoc. M.) (Age 47) Pres., Purdy & Henderson Associates, Inc., New York City.

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SELLS, CHARLES HARVEY (Age 57) Supt. of Public Works, New York State, Albany, N.Y.

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WORSECK, WILFORD HOWE (Age 39) Senior Engr., Div. Engr. Office, Corps of Engrs., UMVD, St. Louis, Mo.

APPLYING FOR ASSOCIATE MEMBER

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ARMSTRONG, ARGYLE EDWARD (Age 30) Seattle, Wash.

ATWELL, KENNETH TILDEN (Jun.) (Age 35) Mgr., Intermountain Builders, Inc., Caldwell, Idaho.

AUTILIO, ALADINO ALFONSO, JR. (Jun.) (Age 35) Field Engr., Sun Oil Co., Cleveland, Ohio.

BANKS, ARTHUR KELLY (Age 29) Cooperative Student, Univ. of Cincinnati; also with State Road Comm. of West Virginia, Charleston, W.Va.

BARTON, JAMES MARION (Age 37) County Engr., Marion County, Hamilton, Ala.

BERRY, NARENDRA KUMAR (Age 27) With Branch of Design and Constr., U.S. Bureau of Reclamation, Denver, Colo.

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CARLSON, GUNNAR JULIUS, Graduate student, Univ. of Minnesota, Minneapolis, Minn.

CARTER, HARRY THOMAS (Age 40) Asst. Bridge Engr., California Div. of Highways, Sacramento, Calif.

CHILSON, MURRAY ALAN (Age 33) Engr., New York Dist. Engr., U.S. Engrs., New York City.

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CLARE JIMENEZ, MANUEL EMILIO (Age 35) With West India Oil Company S.A., San Jose, Costa Rica.

CLARK, SIDNEY WARREN (Age 27) With Aetna Steel Co., Jacksonville, Fla.

CONRAD, HARRY LESTER, JR. (Age 30) Res. Engr. and Mgr., Branch Office, Christman Co., Flint, Mich.

COOPER, ROBERT GEORGE (Age 36) City Engr. and Supt., Water & Light Depts., Rice Lake, Wis.

DANIELS, WARREN SIDNEY (Jun.) (Age 35) Associate Hydr. Engr., U.S. Geological Survey, Boston, Mass.

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DAVIS, WILLIAM BARRY (Jun.) (Age 35) Senior Petroleum Engr., Sinclair Prairie Oil Co., Tulsa, Okla.

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DE GRAZIA, SAMUEL, JR. (Age 38) Chief of Party and Asst. Supt. for Chas. H. Tompkins Co. on West Central Heating Plant, Washington, D.C.

DENAULT, MILTON FRANCIS (Jun.) (Age 34) Topographic Engr. (P-4), U.S. Geological Survey, Minas Gerais, Brazil.

DE OLIVEIRA, WALDEMAR (Age 42) Engr. in Charge, Camp & Housing Sec., São Paulo Tramway, Light & Power Co., and Rio de Janeiro Light & Power Co., São Paulo, Brazil.

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ERSKINE, JAMES ANCONA (Jun.) (Age 34) Asst. Bridge and Bldg. Engr., The Alton R.R., Chicago, Ill.

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GALLAGHER, WALTER VINCENT (Jun.) (Age 35) Engr., U.S. Engrs., Sacramento, Calif.

GETTS, WESLEY FRANCIS (Age 36) Staff San. and Civ. Engr., Donald R. Warren Co., San Francisco, Calif.

GHOSE, NIRAD KUMAR (Age 28) Graduate student in Civ. Eng., Harvard Univ.; permanent address, Bengal, India.

GLEED, GARY SMITH (Age 38) Engr., Southern San Joaquin Municipal Utility Dist., Delano, Calif.

GONSALVES, GEORGE FRANCIS DENNIS (Age 31) Graduate student, Univ. of Utah, Salt Lake City, Utah.

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GURFEIN, JOSEPH INGRAM (Age 29) Graduate student, School of Eng., Harvard Univ., Cambridge, Mass.

HAMLYN, EDWIN ELIAS (Age 36) Associate Engr. (Civ.) (P-3), Special Eng. Div., The Panama Canal, Diablo Heights, Canal Zone.

HEIDTMANN, WALLACE HERBERT (Age 40) Chf. Engr., Purdy & Henderson Associates, New York City.

HITEMAN, LESLIE HENRY (Age 35) Engr. P-3 (Hydr.), Bureau of Reclamation, Amarillo, Tex.

HUDSON, JAMES WALLACE (Age 27) Associate Highway Bridge Engr., PRA, Bridge Office, Div. 15, Alexandria, Va.

JOHNSON, CARL BURDETT (Jun.) (Age 32) Chf. Engr., Latisteel, Inc., Pasadena, Calif.

JOHNSON, JAMES STEELE (Age 42) Chf. Engr., Weihe, Frick & Kruse, Archt.-Engrs., Mill Valley, Calif.

KADIE, CARL HENRY, JR. (Jun.) (Age 36) Dist. Mgr., Bureau of Reclamation, Delta Dist. Office, Sacramento, Calif.

KILLALEE, JACK ADELBERT (Age 47) Senior Hwy. Engr., PRA, Burlingame, Calif.

KLEMA, ROY LESTER (Jun.) (Age 31) Member of firm, Walsh & Klema, Civ. Engrs., Los Angeles, Calif.

KOLODZEY, CHARLES EDWIN (Age 33) Civ. Engr., Humble Oil & Refining Co., Houston, Tex.

KREWATCH, WILLIAM VINCENT (Age 41) Mgr., Plant Appraisal Sec., Du Pont Co., Wilmington, Del.

KULLAS, ALBERT JOHN (Jun.) (Age 30) Stress Group Engr., Glenn L. Martin Aircraft Co., Baltimore, Md.

KURKCIVAN, SIMON YETVART (Jun.) (Age 35) Private practice, Arnavutkoy, Istanbul, Turkey.

LEESON, ELWOOD RICHARD (Jun.) (Age 35) Hydr. Engr. P-4, U.S. Geological Survey, Water Resources Branch, Lincoln, Nebr.

LUECKER, ARTHUR ROWE (Jun.) (Age 31) Civ. Engr., Knappen Eng. Co., New York City.

MACMURRAY, LLOYD CHARLES (Jun.) (Age 35) Graduate student, Dept. of San. Eng., The Johns Hopkins Univ., Baltimore, Md.

MCCOMB, FRED ROBERT (Jun.) (Age 36) Field Engr., Portland Cement Association, Indianapolis, Ind.

MCCREERY, HUGH CHARLES (Age 46) Associate Engr., U.S. Geological Survey, Bismarck, N.Dak.

MCDANIEL, SILAS WINFIELD (Jun.) (Age 29) Project Engr. P-4, FPHA, Tacoma, Wash.

MCKEE, ROBERT BRADFORD (Jun.) (Age 34) Associate Engr., U.S. Engr. Dept., Buffalo, N.Y.

MCWHORTER, WAYNE WHITTEN (Jun.) (Age 34) Erecting Engr., Inc., Eng. and Constr. Div., Koppers Co., Pittsburgh, Pa.

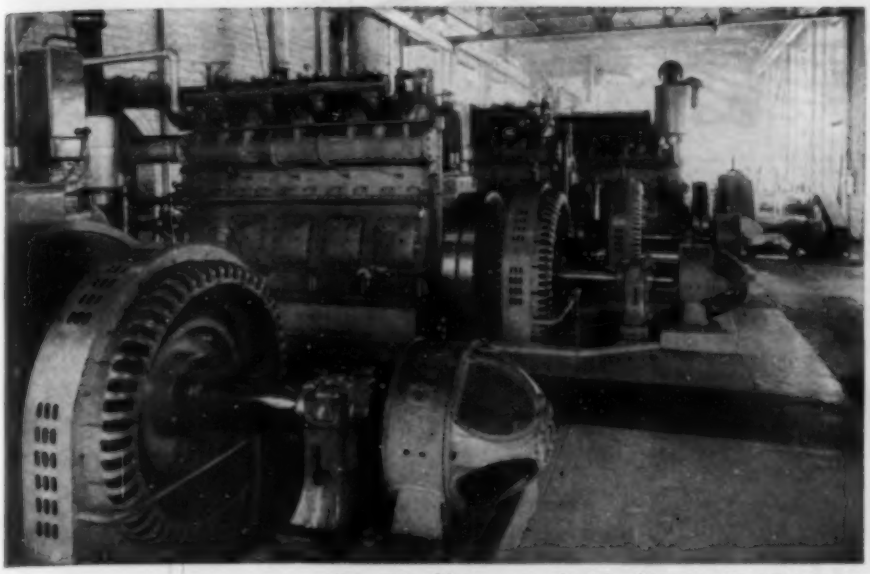
MANDRY, JAMES ELMER (Jun.) (Age 35) Civ. Engr., Denver Design Office, Bureau of Reclamation, Denver, Colo.

MATTERN, GUILFORD LEE (Age 35) Member of firm, Mattern & Mattern, Engrs., Roanoke, Va.

MAXWELL, CLYDE VERNON, JR. (Jun.) (Age 35) Associate with Wm. E. Mallett & Associates, Jackson, Miss.

MOHANTY, HEMANTA KUMAR (Age 31) Design Sec. of Irrigation Eng., Bureau of Reclamation, Denver, Colo.

(*Continued on page 94*)



Four Worthington 4-cycle Diesel Generating Units now operating in the Shenandoah Valley Cooperative plant.

More Worthington Diesels for Shenandoah Valley Cooperative

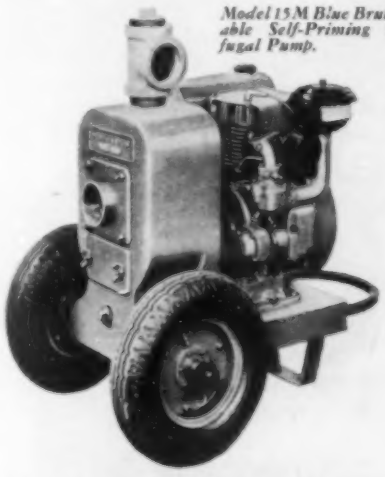
The first rural electric cooperative organization in the United States to manufacture its own current—the Shenandoah Valley Electric Cooperative, serving more than 5,200 consumers in Virginia—has a program for nearly doubling its generating capacity, and has selected Worthington equipment for the purpose.

The present sub-station and switchboard at the plant in Dayton, Virginia, will be replaced with equipment to handle about three times more voltage.

At present, the machinery that produces the electricity is driven by five Diesel engines. The present 2,300 kw generating capacity will be increased by 2,000 kw.

The original installation, in 1937, consisted of three Worthington Diesel Generator units, a 250 hp DS-3 driving a 170 kw generator, a 415 hp DS-5 driving a 285 kw generator, and a 500 hp DS-6 driving a 345 kw generator.

The load grew, and in 1939 Worthington furnished a 1,000 hp EE-8 driving a 700 kw generator. The present order calls for three 1,685 hp SEH-8 units to drive 1,180 kw generators at 360 rpm.



Model 15M Blue Brute Portable Self-Priming Centrifugal Pump.

New Portable Self-Priming Centrifugal Pump

Fast self-priming without re-circulation is the big feature of the new Blue Brute Portable Centrifugal Pumps. Most pumps of this type prime themselves by re-circulating water from the discharge side of the casing back to the impeller suction through priming ports. Blue Brute pumps have none of these troublesome devices. They prime without them.

Basically these pumps are all steel. The casings are fabricated of rust and abrasion resisting steel with smooth, streamlined internal waterways and pleasing external appearance. The impellers are cast of a hard, tough alloy iron and the casings are equipped with renewable hardened wear plates, easily replaced when they have become too badly worn. The entire unit is mounted on a rigid steel base and all sizes except the 1½"-3M rating are equipped with two pneumatic tired wheels.

Blue Brute Portable Self-Priming Centrifugal Pumps conform in all respects to the standards for this type of pump adopted by Contractors' Pump Bureau of the Associated General Contractors of America, Inc., and each unit carries an A.G.C. rating plate which certifies that the pump meets the rigid requirements that have been established. Pumps will be available in all A.G.C. ratings from 1½"-3M to 4"-40M, with larger pumps to follow later.

All pumps are equipped with air-cooled gasoline engines—single cylinder on 1½", 2" and 3" pumps and four cylinder V-type on 4" pumps.

NEWS

FROM THE PUBLIC WORKS FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

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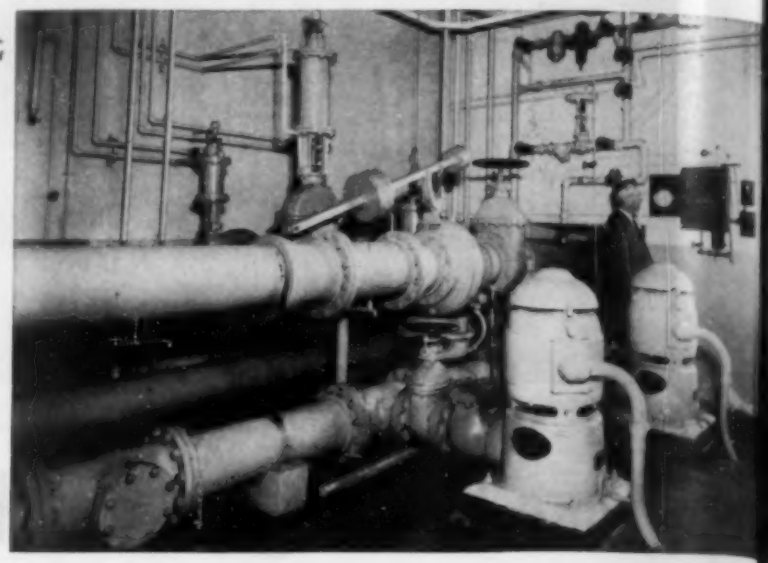
NEWS from the public works front

Two Worthington Vertical Turbine Pumps in new filter plant at Culpeper, Va.



Culpeper Pumps with Worthingtons

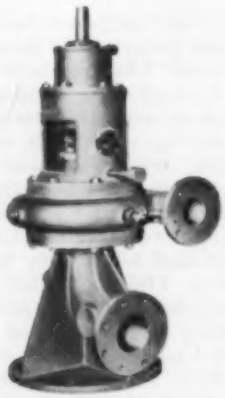
Deep well type turbine pumps furnished by Worthington carry river water to and from the new filter plant installed by the Town of Culpeper, Va.

This plant has a capacity of one million gallons per day, consisting of two one-half million gallon filter units.

The water supply is taken from Mountain Run, a stream approximately 1,000 ft. from the filter plant. A special screened intake structure in the stream permits taking all water, if necessary, during drought periods and the storing of water in the stream bed during periods when the filter plant is not in operation. A 12-in. cast-iron gravity raw water line extends from the intake to the raw water well under the ground floor of the filter building. Two raw water pumps of the deep well turbine type deliver the raw water to the coagulating or settling basins. These pumps have a capacity of 350 gpm each.

The filtered water is pumped to the distribution system and the water storage stand pipe from the clear well by two deep well type turbine pumps, each having a capacity of 350 gpm. Provision has been made for the installation of additional pumps when the water demand increases.

Worthington Centrifugal Pump for pumping sewage.



New Line of Sewage Pumps Announced by Worthington

A new line of "dry pit" centrifugal sewage pumps has been introduced by Worthington. The line consists of seven sizes for each of three types, covering the complete range of requirements. Designs have been standardized for maximum interchangeability of parts.

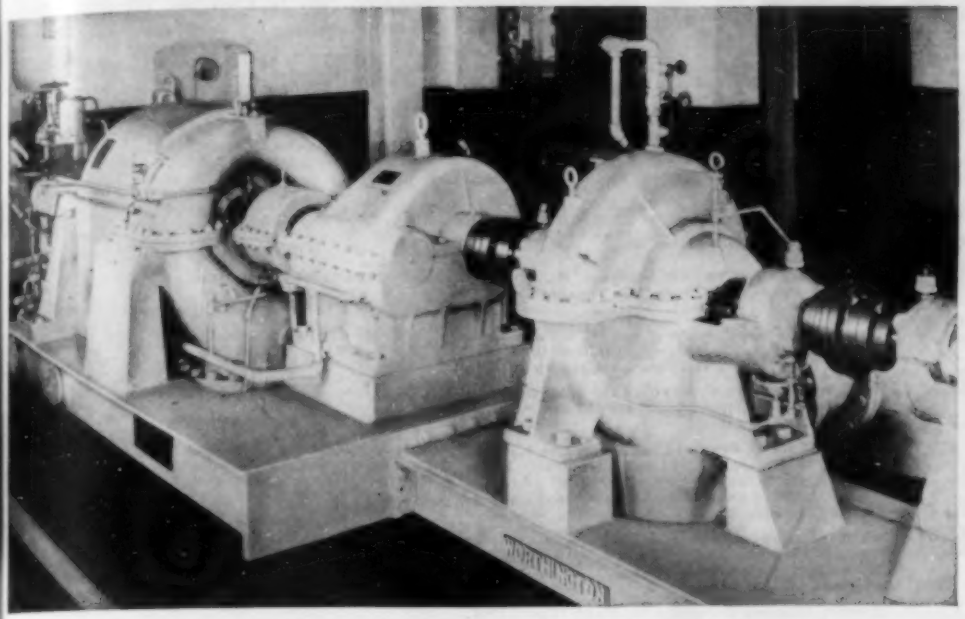
Features of this line include the following: renewable shaft sleeve, heavy-duty ball bearings, positive grease lubrication, non-clogging impeller, and rugged casing.

Line drawings, scale ⅜ in. to 1 in., suitable for tracing in plans, are available to consulting engineers upon request. Also descriptive bulletin W-317-B10.

Straightening Out Highway 37

6 miles of new highway are being built between Indianapolis and Bloomington to straighten out Highway 37. The photo shows two Worthington Blue Brute UMW40 Wagon Drills being driven by two 315 cu ft Blue Brute portable compressors. The contractor is John Bloomer Construction Co., Appleton, Wisc.

public works NEWS



9 mgd Worthington Turbine Centrifugal Pump at York Water Company's pumping station installed in 1946.

30 MGD is Worthington Record at York, Pa.

e of the outstanding water works in the ntry is the plant of York Water Company York, Pa., serving 22,884 connections ough 169 miles of mains. The pumping ion is completely equipped with Worthton pumping units.

n early pumping installation using superted steam was made in 1915—a horizontal ss compound crank and flywheel pumping ine designed for 8 mgd against 312 ft TDH. wo later Worthington installations were made—a horizontal cross compound crank and flywheel pumping engine rated at 5 mgd against 325 ft TDH and a turbine centrifugal unit rated at mgd against 325 ft TDH. In 1946, a second turbine centrifugal was added, rated at 9 mgd against 325 ft TDH. This unit developed a duty of 169 million ft-lb of work per 100 lb superheated steam.

Thus the present Worthington pumping equipment has an aggregate capacity of 30 mgd.

Low Pressure Turbines Power Capitol Air Conditioning

The pumps that serve the air conditioning system here are driven by Worthington-Moore Steam Turbines.

In the power plant connected with the United States Capitol and surrounding buildings Worthington-Moore steam turbines are used to drive the chilled water and condenser water pumps serving the air conditioning system.

Each of the two chilled water pump turbines is rated at 800 hp, and is equipped with separate reduction gears. The turbines operate at 4500 rpm, and the gears reduce the speed to 1450 rpm.

The condenser water pump turbines are rated at 511 hp. They operate at 4500 rpm, and gears reduce the speed to 800 rpm.

In both cases, the turbines operate on steam at 40 lb pressure and exhaust into a vacuum of 26 in.

All four turbines were installed in 1937, and they are used approximately 6 months a year, an average of 16 hours per day.

7-6

Worthington Pump and Machinery Corporation

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Harrison, N. J.

3

Applications for Admission and Transfer

(Continued from page 90)

MURPHY, GEORGE JOSEPH (Age 37) Engr., Parsons, Brinckerhoff, Hogan & MacDonald, South American Dept. of Main Office, New York City.

MUSADDI, LAL (Age 41) Executive Engr., Well Boring Operations Div., P.H.E.D., Cawnpore, India.

MYERS, JAMES WALDEN, JR. (Age 43) Supt., Water Dept., Kenosha, Wis.

O'REILLY, THOMAS CHARLES (Age 46) Surveyor, Water Dept., City of Long Beach, Calif.

OSORIO-STRUVE, LUIS ANGEL (Age 27) Chf. Engr., Municipal San. Sec., Div. of San. Eng., Ministerio de Sanidad y Asistencia Social, Caracas, Venezuela.

PALLER, JACK (Jun.) (Age 32) Engr. P-5, Constr. Dept., Bureau of Yards and Docks, Washington, D.C.; address, Los Angeles, Calif.

PETERS, EDWARD GLADSTONE (Age 31) Estimator, F. H. McGraw, Inc., New York City.

PIERCE, WILLIAM TAYLOR (Age 42) Eng. Dept., Main Office, The Arundel Corp., Baltimore, Md.

PRARGER, CHARLES EUSTACE, JR. (Age 37) Sales Engr., Mosher Steel Co., Dallas, Tex.

QUINTUS DUTOIT, DANIEL FRANCOIS (Age 30) Town Engr., Beaufort West Municipality, Beaufort West, South Africa.

READ, LLOYD CLEMENT (Age 41) Acting Head, Structural Dept., J. B. Pierce Foundation, Raritan, N.J.

READING, THOMAS JAMES (Jun.) (Age 31) Materials Engr., Corps of Engrs., Kansas City, Mo.

RICHARDSON, GEORGE CARL (Jun.) (Age 34) Associate Engr. (Hydr.), Baltimore Dist., Corps of Engrs., Baltimore, Md.

RIGHTER, GORDON TURNER (Age 41) Socony-Vacuum Oil Co. of Venezuela, Caracas, Venezuela.

ROBERTI, LOUIS EUGENE JOSEPH (Age 38) Civ. Eng. Draftsman, Dept. of City Planning, New York City.

SANDERSON, ROY BYRON (Age 32) Asst. Hydr. Engr., U.S. Engrs., Tucson, Ariz.

SANTRY, ISRAEL WOODAN, JR. (Jun.) (Age 30) Asst. Prof. of Civ. Eng., Southern Methodist Univ., Dallas, Tex.

SEN, BIDHU RANJAN (Age 29) Graduate student, Iowa State Coll., Ames, Iowa.

SHANK, HENRY MERCER (Age 50) Civ. Engr., U.S. Forest Service, Ogden, Utah.

SHATTUCK, GEORGE LINAFORD (Age 55) Senior Structural Engr., RFC, Office of Defense Plants, Larchmount, Pa.

SHEEHY, JOHN EDWARD (Jun.) (Age 35) Civ. Engr., Fred J. Early, Jr., Co., Inc., San Francisco, Calif.

SPARKS, WILBUR HAMILTON (Age 44) City Engr., Kamloops, B.C., Canada.

STEARNS, RAYMOND EUGENE (Age 40) Asst. Bridge Engr., California Div. of Highways, Sacramento, Calif.

STOREY, ODES HENRY, JR. (Age 35) Head, Specifications Subsec., U.S. Engrs., Little Rock Dist., Little Rock, Ark.

SUMMERS, DAVID SELDEN (Age 44) Hydrologic Engr., U.S. Bureau of Reclamation, Visalia, Calif.

THOMAS, NORMAN (Age 34) Lecturer in Structural Eng., Univ. of Manchester, Manchester, England.

THOROUGHMAN, FRANK MARION MATHEWSON (Age 36) Engr. (Hydr.), Corps of Engrs., Upper Mississippi Valley Div., Office, St. Louis, Mo.

VALERI, HUGO BONAVENTURE (Age 40) Asst. Regional Engr., ODP/RFC, Washington, D.C., Arlington, Va.

WALTERS, EDWARD EARLE (Age 29) Cons. Engr., Dallas, Tex.

WATKINS, GEORGE REYNOLDS (Jun.) (Age 31) Partner, J. S. Watkins, Cons. Engr., Lexington, Ky.

WHEELEY, HAROLD (Age 40) Project Mgr. and Civ. Engr., J. H. Williams & Co., Inc., Baltimore, Md.

WHETSTONE, GEORGE ARTHUR (Age 35) Asst. Prof. of Civ. Eng., Texas Technological Coll., Lubbock, Tex.

WHITE, SAMUEL JENNINGS (Age 37) Civ. Engr. P-4, Head of P.W.D. Eng. Div., U.S. Naval Submarine Base, Balboa, C.Z.

WOLFORD, DONOVAN SEMLER (Age 35) Senior Research Engr., Research Laboratories, American Rolling Mill Co., Middletown, Ohio.

YASKO, KAREL HENRY (Age 35) Archt. (private practice), Wausau, Wis.

APPLYING FOR JUNIOR

ARORA, GOPAL DASS (Age 25) With Punjab Headworks, Punjab, India.

BREWER, PHILIP WARREN (Age 23) Hydr. Engr., U.S. Geological Survey, College Park, Md.

BUDAY, JOHN FRANCIS (Age 28) Senior Draftsman, Aluminum Co. of America, Hydr. Eng. Dept., Clairton, Pa.

CLAFLEN, GEORGE LEICESTER (Age 26) Instructor in Civ. Eng., Rutgers Univ., Highland Park, N.J.

CNOPS, JAN LODEWIJK (Age 24) Graduate Fellow, Belgian-American Educational Foundation, Dept. of Civ. Eng., Yale Univ., New Haven, Conn.

DU PLESSIS, JOHN VERNON (Age 22) Asst. Engr., African Realty Trust, Ltd., Johannesburg, Natal, Union of South Africa.

EICHENBERG, URANO CAVEDON (Age 26) Graduate student, Univ. of Michigan, Ann Arbor, Mich.

FENTRESS, DONALD LEROY (Age 27) Engr. Aide SP-5 (Civ.), Corps of Engrs., Portland, Ore.

FORSTER, JOHN WILLIAM (Age 24) Lecturer in Hydraulics and San. Eng., Univ. of Alberta, Edmonton, Canada.

FRETTO, PATRICK (Age 25) Eng. Aide with Industrial Waste Engr. of Los Angeles County, Los Angeles, Calif.

GIBSON, JOHN SIMS (Age 31) Jun. Engr., Grade 2, Myers & Noyes, Cons. Engrs., Dallas, Tex.

GRAVES, WALTER THOMAS (Age 28) Instructor, Civ. Eng. Dept., Univ. of Minnesota, Minneapolis, Minn.

JACUS, WILLIS ARTHUR (Age 27) Draftsman with Walter H. Wheeler, Cons. Engr., Minneapolis, Minn.

LEE, CHARLES EDWIN (Age 26) Engr. P-2, Asst. to Project Engr., Mun. Eng. Div., Diablo Heights, C. Z.

LLEO DE LA VINA, ANTONIO (Age 27) Chf. of Work in Grandson, S.A. (Contrs.); also Research Engr., Spanish Inst. de la Construccion, Madrid, Spain.

McGAUGHEY, JOHN CAMERON (Age 23) Structural Designer, Eng. Dept., J. P. Stevens Co., Atlanta, Ga.

MATHUR, CHHAIL BEHARI LAL (Age 27) Asst. Engr., Public Works Dept., Bikaner (Rajputana), India.

MENDES DE OLIVEIRA CASTRO, MARIO (Age 27) Jun. Engr., Companhia Auxiliar de Empresas Electricas Brasileiras, Rio de Janeiro, Brazil.

MONK, CLARENCE BURLEIGH, JR. (Age 26) Instructor in Theoretical and Applied Mechanics, and Graduate Student in Civ. Eng., Univ. of Illinois, Urbana, Ill.

MORRIS, MORTON DAN (Age 25) Engr. (Civ.), Dist. Real Property Control Officer, Corps of Engrs., Okinawa Dist.

NAJMAL-HAQUE, SHARIF MOHAMMAD (Age 25) Student, Cornell Univ., Ithaca, N.Y.

NUGENT, JOHN PATRICK, JR. (Age 28) Jun. Engr., Knappen Eng. Co., New York City.

PARKS, GEORGE HOLSTIEN, JR. (Age 26) Asst., Harrop & Hopkins, Civ. & Mining Engrs. and Land Surveyors, Wilkinsburgh, Pa.; address Augusta, Ga.

RANSFORD, GEOFFREY DAVID (Age 22) Asst. Engr., State Rivers and Water Supply Comm., Victoria, Australia.

RAO, KANNAJE RAMESH (Age 23) Graduate student, Hydraulics, Univ. of Iowa, Iowa City, Iowa.

SINGH, SARANJIT (Age 25) Graduate student in Agri. Eng., Iowa State Coll.

SPARKS, GEOFFREY VINCENT (Age 23) Designing Engr., Gutteridge, Hastings & Davey, Melbourne, Victoria, Australia.

ALA. POL. INST.

	Age
TRUSS, MONTGOMERY VANCE, 1947	(25)

UNIV. OF ARIZ.

FERGUSON, ARCHIBALD EDWARD, 1947	(25)
LEVIN, SIGMUND LOUIS, 1947	(30)
MCINTOSH, WILLIAM FRANCIS, 1947	(29)
MEES, QUENTIN MICHAEL, 1947	(28)
PETERSON, HAROLD BURKE, 1947	(23)
SHULL, IRWIN INGRAM, 1947	(25)
SLUTZKY, HAROLD SEYMOUR, 1947	(24)

BROWN UNIV.

WATTS, GEORGE MILTON, 1947	(25)

CARNEGIE INST. TECH.

KOHN, STANLEY JOSEPH, 1947	(24)

CASE SCHOOL OF APPLIED SCI.

BARNES, ALBERT HASBROUCK, 1943	(25)

CLEMSON A. & M. COLL.

GALWAY, JACK EDWARD WARREN, 1947	(27)
HENDRICK, HOYT LEGRAND, 1947	(23)
MCKINNON, ROBERT KENNEDY, 1947	(21)
MAYS, HARRY ROY, 1947	(23)
POTTER, JAMES ROBERT, 1947	(23)
WILSON, MARVIN ERNEST, JR., 1947	(23)

COLO. A. & M. COLL.

CERMAK, JACK EDWARD, 1947	(24)
DAVIS, RICHARD ORTON, 1947	(28)

COLUMBIA UNIV.

DREYER, JOHN VICTOR HERBERT, 1947	(21)
FITZPATRICK, WALTER CORNELIUS, 1947	(26)
FOX, EDWARD ALEXANDER, 1947	(26)
FRANKFURT, DANIEL, 1947	(22)
SILBERT, LOUIS, 1947	(20)
SMITH, RENÉ EMILE GEORGE, 1947	(23)

DARTMOUTH COLL.

CHADWELL, HARRIS JESSE, 1947	(21)
GRAVES, HARRY ELMER, 1947	(22)
HELM, CYRUS VARD, 1947	(21)
OLKO, STEPHEN MARTIN, 1947	(21)
STIFLER, FELIX ROYSTON, JR., 1947	(22)

DUKE UNIV.

MASTERS, RICHARD WARREN, 1946	(21)

GEORGE WASHINGTON UNIV.

LANE, JOHN MCALLISTER, 1947	(25)

GA. SCHOOL TECH.

FOLWELL, WILLIAM HOPKINS, 1947	(23)
MERGNER, WILLIAM, 1947	(25)

ILL. INST. TECH.

VLAD, ERNEST JULIUS, 1947	(31)

IOWA STATE COLL.

NEDDERMAN, WENDELL HERMAN, 1943	(25)

STATE UNIV. OF IOWA

NIAZ, SADIQ MOHAMMAD, 1947	(20)

LEHIGH UNIV.

APPEL, DAVID WOODHULL, 1947	(22)

LA. STATE UNIV.

AUFFANT, EUGENE JOSEPH, 1947	(22)
POLKYNARD, SIDNEY LEONARD, 1947	(30)
ROBBINS, WARREN MATTHEW, 1947	(20)

MICH. COLL. OF MIN. & TECH.

SCOTT, EDWARD PAUL, 1947	(25)

MICH. STATE COLL.

GABLE, TOM SCHULTE, 1947	(23)

UNIV. OF MICH.

MULLIGAN, ROBERT DAVID, 1947	(32)

UNIV. OF MINN.

SHORT, ROGER BARTON, 1942	(26)

MONT. STATE COLL.

DOUGHERTY, CHARLES NELSON, 1947	(25)
MCCULLOUGH, DAVID WESLEY, 1947	(24)
WILDE, EUGENE RICHARD, 1947	(30)

NEWARK COLL. OF ENG.

KAELBERER, JOHN MATTHEW, 1947	(23)
LENOX, STANLEY, 1947	(23)
LEONARD, GEORGE ELY, 1947	(26)
LIPSCHULTZ, MORTON SYLVAN, 1947	(24)
LOESER, HARRY FREDERICK, 1947	(25)
OSBORNE, ROBERT WILLIAM, 1947	(24)

NORTHWESTERN TECH. INST.

SCHULTZ, JOHN AUGUST, JR., 1947	(22)

OKLA. A. & M. COLL.

BERRY, GENE ALLEN, 1947	(23)

UNIV. OF OKLA.

ARONSON, HARVEY, 1947	(23)
BRAKEBILL, CECIL AMOS, 1947	(22)
EBELING, HAROLD OMAR, 1947	(25)
FINLEY, WILLIS WILSON, JR., 1947	(27)
FRANK, BEN, 1947	(24)
KILLIAN, CLOVIS GENE, 1947	(25)
MIKLES, EDGAR VERNON, 1947	(30)
MORGENSEN, DEAN, 1947	(21)
RICHARDSON, KENNETH WALLACE, 1947	(23)
ROBERTS, JASPER KENT, 1947	(25)
SHORT, KENNETH ROY, 1947	(28)
STEPHAN, SAMUEL CHESTER, JR., 1947	(20)
WRIGHT, CHARLES EDWARD, 1947	(26)

ROSE POL. INST.

WHITE, JOHN RICHARD, 1947	(24)

UNIV. OF S.C.

MCCALLEY, ROBERT BRUCE, JR., 1947	(24)

STANFORD UNIV.

SEAVER, BARBARA, 1946	(21)

SYRACUSE UNIV.

DUNBROOK, HARRISON FREDERICK, 1947	(26)
NOTTENBURG, GLADYS SHIRLIE, 1947	(21)

WASHINGTON UNIV.

DREILING, HARRY ROY, 1947	(26)

W.VA. UNIV.

PITTHAN, ROBERT WALTER, 1947	(24)

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Welding Equipment

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Remember this fact! Everything electrical for industrial buildings—to *produce, distribute, control* and *utilize* electric power—can be obtained through Westinghouse and its Distributor Organization.

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Call your nearest Westinghouse District Office or Distributor for full information on this co-ordinated service. Also ask for the new Architect's and Engineer's Data Book, containing 362 pages of electrical equipment data, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-94753

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CIVIL ENGINEER; Jun. ASCE; B.S.; young; single; experienced in structural analysis, engineering materials testing (their uses and products); also additional study in contracts and specifications; desire position as sales engineering or field representative. Will travel. Available immediately. C-376.

CIVIL ENGINEER; Jun. ASCE; 28; married; graduate; licensed; experienced in design of timber, concrete, and steel structures for industrial buildings. Available on 4 weeks' notice. Location preferred, Pacific Coast. C-377-474-A-13.

CIVIL ENGINEER; Assoc. M. ASCE; licensed P.E.; age 47; over 20 years' varied experience, office and field—consultant, supervision, direction, and report writing on all phases of engineering and construction. Complete command of Spanish. Willing to travel. Excellent references. Available on one month's notice. C-378.

FIELD ENGINEER ON CONSTRUCTION; Jun. ASCE; 31; married; 2 years' experience with Washington State Department of Fisheries on design of small timber and concrete structures, design and location surveys of pipe lines and topographic surveying. Available July 15. Location preferred, Southwest. C-379-475-A-6.

CIVIL AND ARCHITECTURAL ENGINEER; Assoc. M. ASCE; 43; married; 25 years' experience, have also had own consulting architectural and engineering firm. Experienced architectural-structural design, supervision; preparation, presentation of projects; experimental production of low-grade aggregate concrete hollow blocks. Available in September for Brazilian, Central or South American projects. Fluent French and Italian; some Spanish and Portuguese. C-380.

CIVIL ENGINEER; Assoc. M. ASCE; 38; registered; B.S. in C.E.; Lt. Comdr., CEC, U.S.N.R. (inactive); married; broad experience in heavy construction, railroad and highway construction, and administration of all types of construction. Will accept foreign assignment if family quarters are available. C-381.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application.

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Instructors, Professors of All Ranks, Lecturers, and Teaching Assistants in Civil, Electrical, and Mechanical Engineering

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Positions Available

CIVIL ENGINEER, under 30, with some experience on line and grade, transit and inspection. Salary, $3,120 a year. Location, Staten Island, N.Y. W-9052.

ENGINEERING ASSISTANT, civil or mechanical graduate, with at least 3 years' experience laying out building alterations, store fronts, and equipment, to do drafting, assist in estimating and preparing specifications, etc. Must be good letterer. Salary, $3,900 a year. Location, New York, N.Y. W-9054.

ENGINEERS. (*a*) Structural Engineer, 30–40, with at least 5 years' experience in structural concrete design work. Will act as squad boss in drafting room. Salary open. (*b*) Structural Designers for designing and checking, especially reinforced concrete structures. Must be willing to do some drafting and designing on the board. Salary, $5,200 a year. Location, New York, N.Y. W-9063.

ENGINEERS experienced on construction of several sizable steam-electric power plant projects. Require men experienced not only in the building of structural parts of the project, but also in laying out and supervising the installation of boilers, turbo-generators, pumping equipment, condensing equipment and other auxiliary equipment, including steam and water piping. Location, North Carolina. W-9066 (*b*).

INSTRUCTOR TO ASSOCIATE PROFESSOR, civil engineer, with M.S., who has specialized in fluid mechanics, to teach fluid mechanics theory and laboratory; should be capable of designing hydraulic laboratory equipment. Salary, $2,800–$5,400. Location, Indiana. W-9077 (*a*).

JUNIOR FIELD ENGINEER, civil graduate, with experience, for excavation and foundation contractor. Salary, $2,400 a year. Location, New York, N.Y. W-9096.

FIELD ENGINEER, civil graduate, with rock tunnel and heavy construction experience, to be assistant engineer for a contractor. Considerable traveling. Salary open. Location, Massachusetts. W-9098.

SUPERINTENDENT OF CONSTRUCTION, graduate civil engineer, with experience. Will also estimate quantities. Salary, $2,600–$4,160 a year. Location, New York, N.Y. W-9102.

TEACHING PERSONNEL for Civil Engineering Department. (*a*) Associate Professor to head division of hydraulics and hydrology and to lead research in beach erosion, water conservation, and hydraulics. Salary, $4,800–$5,600 a year. (*b*) Associate Professor to lead division of sanitary engineering and public health engineering. Developed facilities as good as any in the country; good opportunity for right man. Work includes academic and research leadership. Salary, $5,400–$5,800. (*c*) Assistant Professor of structures with knowledge and experience in experimental stress analysis, particularly polarized light and deformater equipment. Opportunity to lead research work. Salary, $4,200–$4,800. Location, Florida. W-9123.

INSTRUCTORS IN CIVIL ENGINEERING, to teach strength of materials, materials laboratory, surveying and structural drafting. Salaries, $2,500–$3,000. Positions start in September 1947. Location, Texas. W-9162.

RESIDENT ENGINEER, civil graduate, with at least 10 years' hydroelectric construction experience, to act as owner's representative in charge of tunneling, dam construction, equipment installation, and keeping costs on general contract. Salary, $6,000 a year. Location, Upstate New York. W-9178.

ARCHITECTURAL OR CIVIL ENGINEER, 30–40, with construction experience, to supervise new construction, repairs, and maintenance of gasoline service stations and bulk plants. Prepare bid proposals, attend to correspondence, write reports, make sketches, layouts, and outside inspections. Some traveling. Salary, $3,600 a year. Headquarters, New York, N.Y. W-9194.

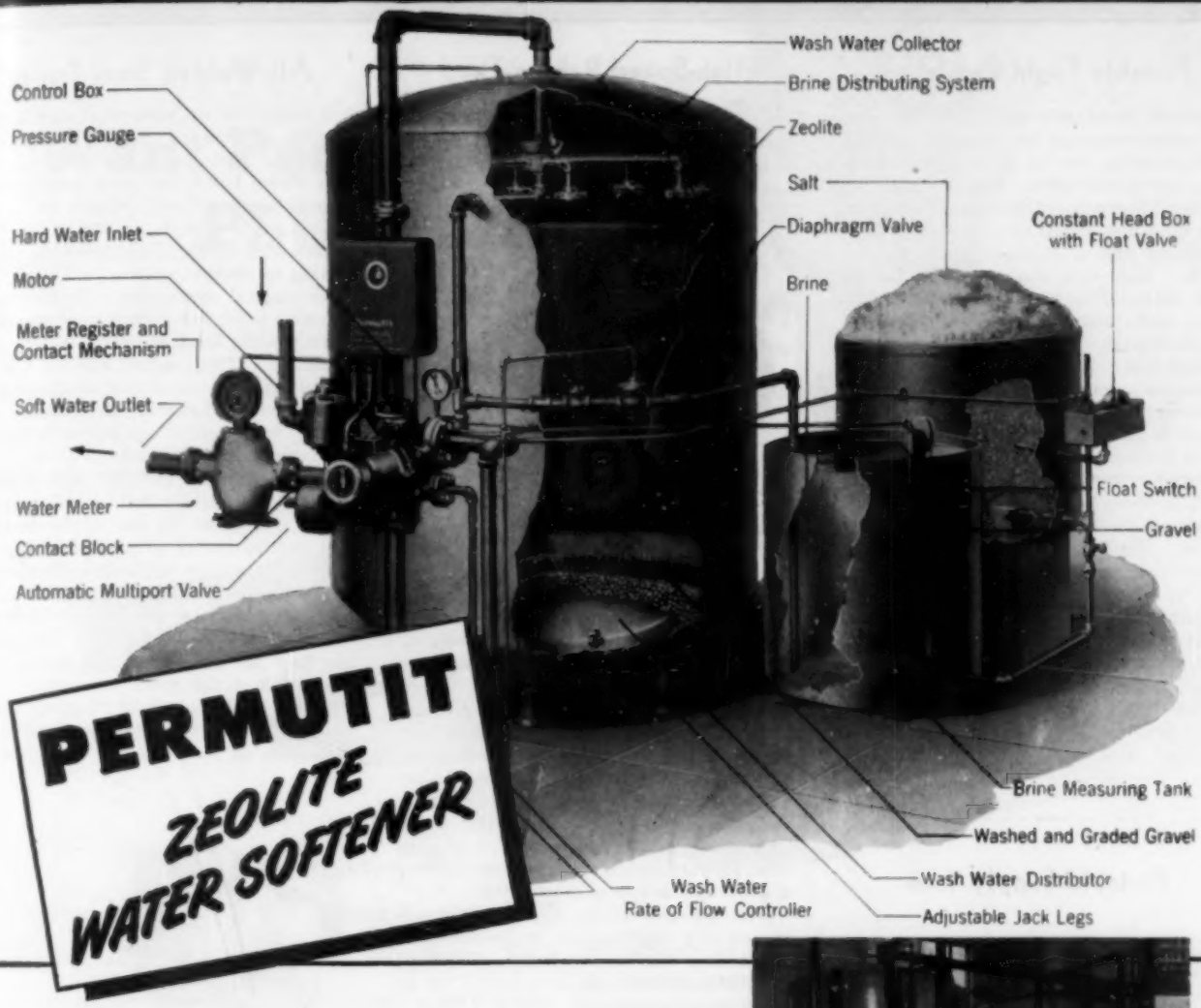
FIELD ENGINEER, civil graduate, with structural experience in the construction of steam power plants. Duration, 2 years. Salary, $4,680 a year. Location, Pittsburgh Area. W-9200.

ENGINEERS, Two. One to undertake and supervise design and direction of extensive dredging operations; the other to direct the construction of piers and docks. Location, Argentina and Brazil. W-9219.

INSTRUCTORS of various ranks for rapidly developing school of engineering. Men with advanced degrees, teaching or professional experience desired. Openings in civil, mechanical, metallurgical, and electrical engineering. Location, Massachusetts. W-8923.

STRUCTURAL ENGINEER particularly experienced in reinforced concrete, living in or around Chicago. Position will require travel as consulting engineer for promotional organization, promoting the use of cement. Salary, $4,800–$6,000 a year. R-4254.

Completely Automatic-



THE zeolite process—originated by Permutit—is the *simplest method* for removing hardness from water. Original cost of equipment is lower than that of any other form of water softening. And in Permutit's *completely automatic* zeolite softener, the process reaches its highest efficiency.

In a Permutit* automatic zeolite unit—simple and compact—the water is softened under positive electrical control . . . with a minimum of attention, a minimum of manpower. Backwashing, regeneration and return to service are all automatic. Process is particularly adaptable to well waters.

Thousands of these units have been installed, not only in municipal service, but also in industry. Smaller units are available for private homes.

Our staff will be glad to work with you and your consultants in selecting the best type of water treatment for your community. Write The Permutit Company, Dept. CE7, 330 West 42nd Street, New York 18, N. Y., or Permutit Co. of Canada, Ltd., Montreal.

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Here's a modern Permutit Automatic Zeolite Water Softener, recently installed. It backwashes itself, regenerates and returns to service—automatically. It's the last word in simple, effective, efficient water conditioning.

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WATER CONDITIONING HEADQUARTERS

Equipment, Materials and Methods

New Developments of Interest, as Reported by Manufacturers

Portable Flight Conveyor

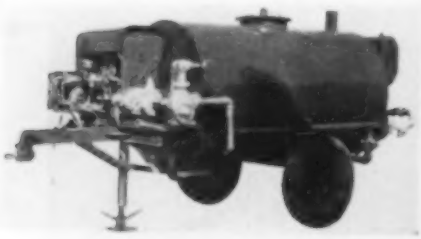
A NEW PORTABLE flight conveyor for conveying materials at steep inclines has been added to the extensive line of portable power conveyors manufactured by Material Movement Industries of Chicago. It is known as Model CFL Tote-All Flight Conveyor and is available in 14 ft. and 20 ft. This new conveyor will handle bulk material such as coal, dirt, ashes, grain, and similar products at inclines up to 45 degrees. Two-inch flights bolted to steel roller chain, on 1-ft. centers, assure minimum amount of product "roll-back."

Power is furnished by either electric motor or gasoline engine which will handle up to 60 tons per hour of 50 lb. per cu. ft. material. Maximum discharge height: 14-ft. models, 10 ft.; 20-ft. models, 14 ft. Minimum discharge height of both models is 4 ft. Flight speed is 100 fpm. Overall frame width is 13¾ in. and trough width is 10¼ in.

Tote-All Flight Conveyor comes mounted on the popular Trail-Hoist (combination trailer and hydraulic lifting device) for easy moving.

Descriptive literature on request. Material Movement Industries, 310 S. Michigan Ave., Chicago 4, Ill.

Portable Supply Tank



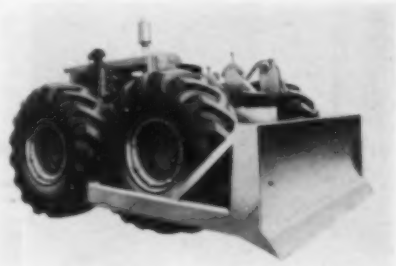
A 1,500 GALLON single-compartment Portable Supply Tank is being built by Wood Manufacturing Co., North Hollywood, California. Designed for use with the self-propelled Wood Roadmixer, Model 36 (or Models 48 and 54) and other traveling mixing plants, this unit is used for carrying all types of binder fluid.

A 3-in. Roper Pump powered by a Chrysler industrial engine is mounted at the front of the tank. This pump is used for loading the tank, transferring fluids from tank to mixing drum on Roadmixer, or travel plant, and for circulating fluids within the tank while heating.

Tank is available without insulation or heating equipment, or with heating equipment only. A 24-in. manhole allows entrance for cleaning.

High-Speed Rubber-Tired Tournadozer

A NEW HIGH-SPEED rubber-tired Tournadozer has been announced by R. G. LeTourneau, Inc., Peoria, Ill.



This Model C Tournadozer, latest addition to the LeTourneau line of rubber-tired earthmoving and construction equipment, is powered by a 160 h.p. diesel engine. It has four forward speeds ranging up to 12 miles per hour, and the same four speeds are available in reverse.

Engineered to extend the speed and economies of rubber-tired equipment into the dozer field, the Tournadozer features many new developments in design. It has a Tournamatic constant mesh transmission. With this transmission, the operator can select any gear ratio or change from forward into reverse with no shifting of gears and no loss of momentum.

The operator steers by use of air-actuated disk clutches and brakes controlling the two wheels on each side. The bowl is cable-controlled and is operated by an air-actuated power unit.

Mounted on four 14×32 taper bead tires, the Tournadozer is designed so that as power requirements increase because of digging or push loading, greater weight is put on the tires, giving them more ground-gripping traction and flotation.

New Type Hydraulic Door Closer

A NEW TYPE hydraulic door closer built like a hinge has been announced by Bakewell Products Company. Eliminates all visible door-closing mechanism. Notl ing "buried"; nothing over head. Spring and hydraulic units completely concealed within specially designed butt hinges. Installed same as conventional butts. Bakewell Hydro-Hinge does not restrict architectural detailing of door or trim. Adjustable for varying speeds, positive latching or silent closing. Tamper-proof and non-leakable. Sizes and finishes for residential, commercial and industrial installations. Manufactured by Bakewell Products, 1201 Rio Vista Avenue, Los Angeles 23, California.

All-Welded Steel Trailer

A LIGHTWEIGHT, all-welded steel trailer, capable of hauling heavy construction equipment while being towed by an ordinary dump truck, has been marketed by Rogers Brothers Corp., Albion, Pa.

The unit, known as the "Tagalong Frontloader Trailer," simplifies the transporting of shovels, cranes, bulldozers and other capital equipment. Welded construction is used to permit maximum joint rigidity while keeping overall weight at a minimum. The Lincoln Electric Co., of Cleveland, Ohio, supply the welding equipment used in fabricating the trailer.

The construction equipment is loaded from the front of the trailer, with the drawbar resting on the ground. A steel cable is pulled out slightly and looped around a pulley located at the end of the drawbar and another pulley which is a component of the connecting apparatus attached to the truck. As the dump body is elevated, the cable lifts the drawbar which forces the towing tongue into a slot. The safety coupling pin is inserted, the dump body lowered and the truck is ready to roll with the trailer and load "tagging along" behind. Trailers are produced with load capacities of 10 tons, 15 tons, and 20 tons.

Hi-Temperature Resistant Concrete

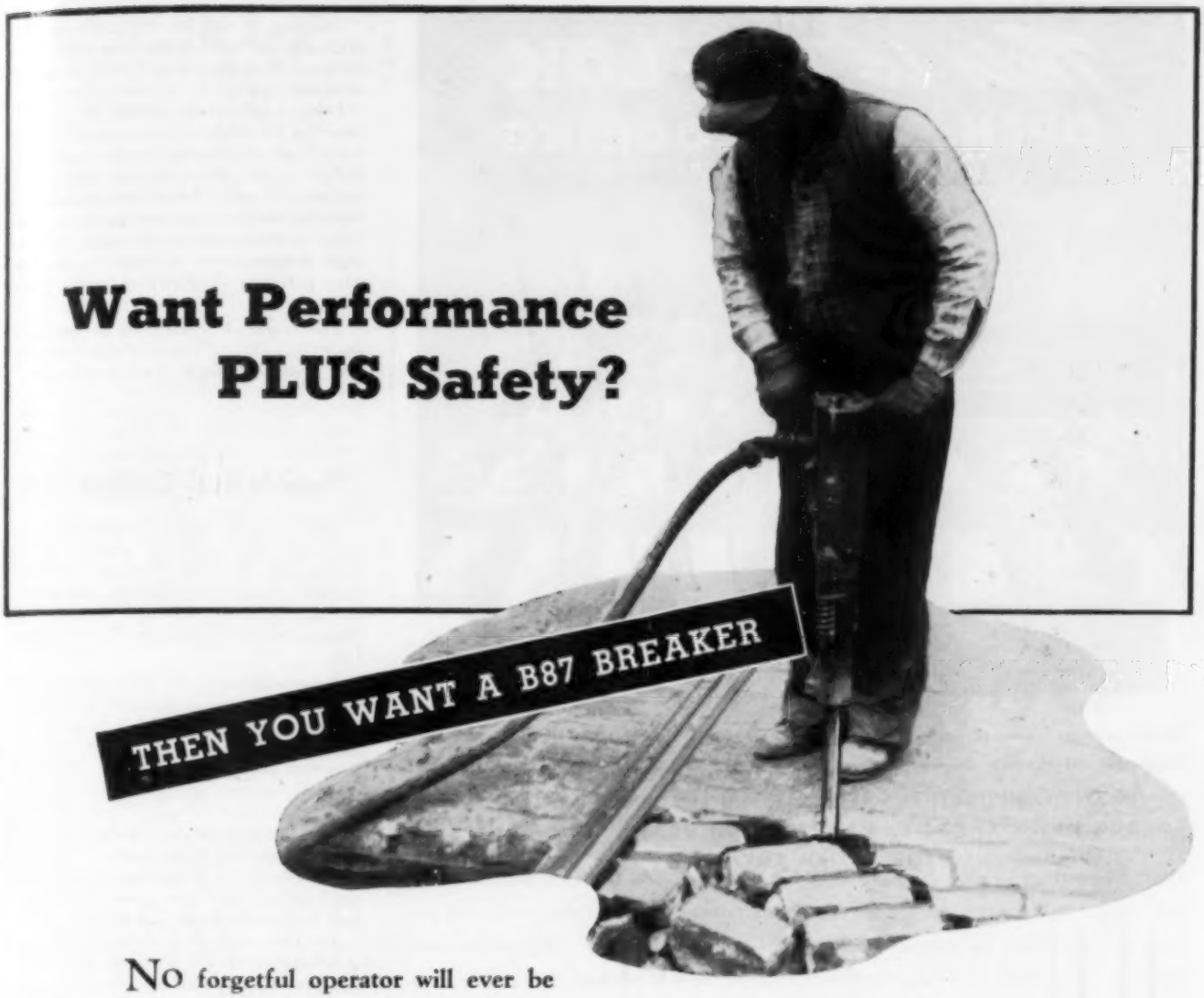
A CONCRETE WHICH easily withstands temperatures as high as 3,000 F has been developed by The Babcock & Wilcox Company, known as "B & W KAO-CAST"; fills a need for a refractory castable in the construction of industrial furnaces operating at temperatures ranging from the top limit of standard refractory castables up to as high as 3,000 F.

Both in service trials and in laboratory tests, the material has shown excellent stability and resistance to spalling (disintegration) under repeated heating and cooling cycles. Other properties which give Kaocast its durability include its exceedingly small volume change on initial firing, and its lack of shrinkage or expansion under continuous use at high temperatures.

This is TRI-LOK

Because it can be either poured like ordinary concrete or used as a ramming

Want Performance PLUS Safety?



NO forgetful operator will ever be injured in moving a Gardner-Denver B87 Paving Breaker from place to place. This breaker is equipped with a new safety latch which enables it to be moved without shutting off the air. Working exactly like the "safety" on a gun, this latch prevents accidental opening of the throttle.

This highly efficient paving breaker, the B87, is easily convertible to a sheeting driver by removing the standard chuck and substituting jaw type sheeting driver head. Here are other features of the B87 that your men will like:

- *Easier to handle—a shorter breaker that offers more convenience either with standard length chisels and gads or with longer points.*
- *Oil and air economy — no joints on the B87 Breaker are under air pressure — there's no wasteful leakage of air or oil.*
- *Cooler handles — because air inlet is at side of cylinder, not through backhead.*
- *Positive built-in lubrication — integral reservoir provides for 5 hours normal operation.*
- *Better tool retainer — no nuts to work loose on the B87 — the extra heavy forged retainer pivots on a substantial pin held positively in place.*

USE COMPRESSED AIR FOR SAFETY CONVENIENCE FLEXIBILITY

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SINCE 1859

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Gardner-Denver Company, Quincy, Illinois

International Harvester

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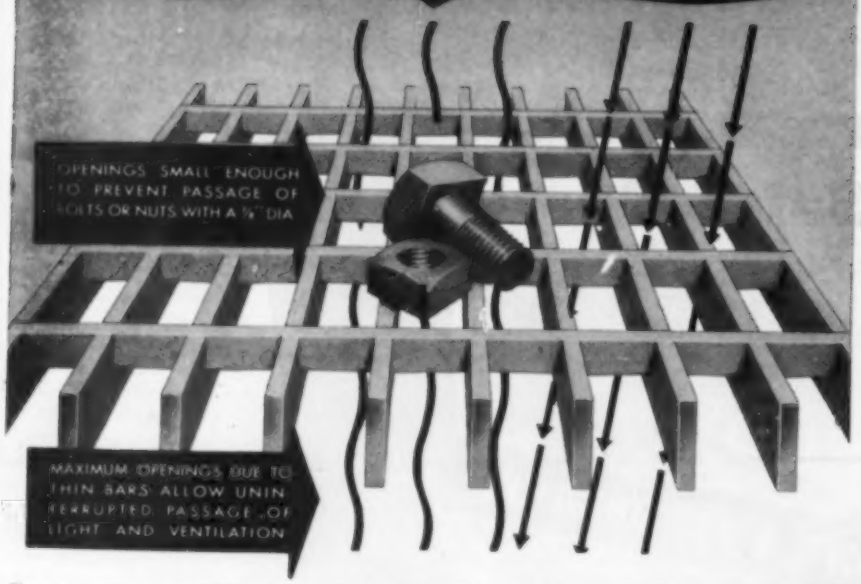
OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ½" DIA
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Because it can be either poured like ordinary concrete or used as a ramming mixture, B & W Kaocast will effect considerable savings in furnace construction.

Other applications include its use as a covering for studs in water-cooled furnace walls and in forming high temperature baffles. Also, it is suitable for use on furnace car tops, which are subjected to repeated heating and cooling cycles. Because its volume change is negligible under high temperatures, Kaocast is ideal for deep patching of spalled or eroded brickwork.

The material is supplied in dry form, ready mixed, and requires only the addition of water to make it ready for use.

Portable Rock Crushing Plant

ONE OF THE latest developments in portable rock-crushing plants is the Cedarapids Portable Primary and Hammermill Plant combination which is a postwar accomplishment of the Iowa Manufacturing Company, Cedar Rapids, Iowa.

Especially new in this combination is the 40 × 33-in. hammermill pulverizing unit, the main power for which is a General Motors Twin-6 engine, trailer or truck-mounted as a separate unit. This hammermill features absolute control of the finished product by size of grate openings so that the operator can regulate size of the finished product from roadstone down to agstone or in any desired approximate proportions of the two. The hammermill unit has a capacity of 120 tons per hour.

The primary unit in this combination is a self-contained 25 × 40-in. jaw crusher mounted on three axles with twelve pneumatic tires and air brakes. Compact high-speed Diesel "package power" engines have been found to be the best source of power for this unit.

The secondary or hammermill unit receives the crushed rock from the primary unit and passes it from a hopper by way of an elevating conveyor to a horizontal double deck Cedarapids vibrating screen. Screen meshes vary in size from $^{3}/_{4}$ in. to $1^{1}/_{2}$ in. on the top deck, and from $^{1}/_{2}$ in. to $^{5}/_{16}$ in. on the lower deck, depending upon the size of material to be selected. Rocks that are too large to drop through the top deck of the screen are passed along to the hammermill where the crushing operation breaks them into the desired size. They are then returned to the screen feed conveyor by means of an elevator wheel. The material that drops through the top deck screen openings falls directly on the lower deck screen where the roadstones are separated from the finer agstone. Dropping through the lower screen mesh, agstone is deposited on a truck loading conveyor. A second loading conveyor takes off the roadstone which is larger and does not pass through the screen.

The portable power unit used in driving the hammermill features a GM Twin-6 engine, two 6-cylinder General Motors Series 71 Diesel engines mounted together and driving a single shaft through 1.77 to 1 reduction gear box.

International Harvester Announces Power Units

START OF PRODUCTION on a 125-hp Model UD-18A power unit and a 76-hp Model UD-14A was recently announced by International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. Both power units are heavy-duty four-cycle Diesels with the same bore and stroke. Both units are assembled at International Harvester's Melrose Park Works.

The UD-18A and UD-14A deliver in full measure considerably more power without increase in weight over the popular UD-18 and UD-14 models which they displace. A new cylinder head arrangement, improved nozzles, and redesigned precombustion chambers give them higher compression and greater efficiency in converting fuel energy into low-cost power. Since the International Diesel starting system does not require preheating of the incoming air even in cold weather, it has been practical to locate the exhaust manifold on the injection side of the engine, away from the intake manifold. As a result, incoming air is kept cooler. Volumetric efficiency or "breathing" ability, is greatly increased resulting in more lugging ability and greater power output with clean combustion. Both power units achieve their higher rpm and increased horsepower with ordinary lubricating oil of goodquality. An oil control ring of a new type assures satisfactory cylinder lubrication.

International's integral gasoline starting system has been retained. The engines are started on gasoline in the same manner as an ordinary gasoline engine; movement of a single lever changes the engine from the gasoline starting cycle to four-cycle Diesel operation.

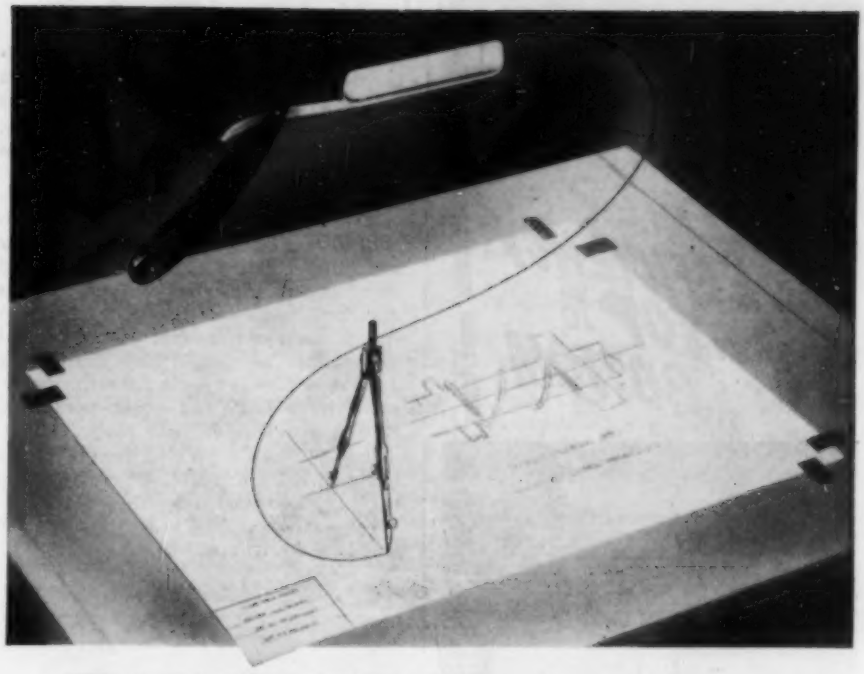
The UD-14A and UD-18A are available for many different kinds of jobs in a variety of equipment combinations from engines to complete power units ready for operation.

High-Capacity Feeder

DESIGNED TO MEET the high-capacity, long-distance feeding problem of a Pacific Coast contractor handling railroad ballast, the new Super-Duty Feeder of Lippmann Engineering Works, Milwaukee, gives an operator flexibility in his feeding operations. The first unit was 35 feet long, and operating tests show that any reasonable length can be built.

High strength is achieved because the endless conveyor is fabricated of cast steel plates, hinged together with heat-treated alloy steel pins. The plates are reinforced with ribs to withstand severe impact and move on heat-treated high carbon steel rollers over sprockets on each side. The rollers, in turn, revolve on an abrasion resistant steel track.

Anti-friction bearings are used throughout, and the ruggedness of the feeder is keynoted by the 18 inch deep, wide-flanged beams that constitute the main frame. For further details, write Lippmann Engineering Works, 4603 W. Mitchell Street, Milwaukee, Wisconsin.



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OPENED OR CLOSED—or in action—Kinnear Rolling Doors offer greater efficiency "from top to bottom."

They open straight upward, coiling compactly above the doorway out of reach of damage by wind or vehicles. They clear the entire doorway, leaving all surrounding space fully usable at all times.

When closed, Kinnear Rolling Doors offer the extra protection of all-steel construction—against wind and storm damage . . . theft or intrusion . . . fire or explosion.

The rugged Kinnear Motor Operator can be added to any Kinnear Rolling Door for maximum speed and ease of operation, with push button controls at any desired point.

Kinnear Rolling Doors are built in any size, for new or old buildings. Write for new catalog.

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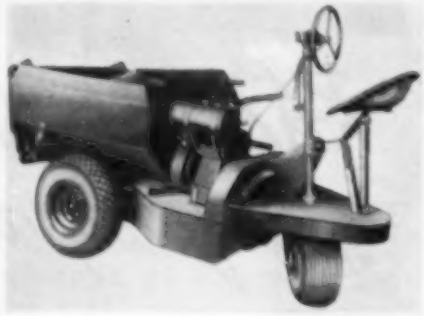
Saving Ways in Doorways
KINNEAR
ROLLING DOORS

Mechanized Wheelbarrow

PRODUCTION OF A mechanized wheelbarrow capable of carrying a one-ton load at speeds up to 15 miles per hour has been announced by Novo Engine Co., Lansing, Mich., manufacturers of construction equipment.

The unit, which is called Scootruk, is virtually a miniature dump truck. It is built to haul concrete, sand, bricks, mortar and other building materials. Equipped with special airplane-type tires, it runs anywhere, even on loose sand, without special roads or runways. It can be used for scaffold or second and third story work since it weighs only 1,000 lb. Steering is by a single tail wheel, permitting easy maneuvering in tight places and enabling it to turn in its own length. Power is supplied by a 6 h.p., air-cooled Novo engine. A 4-speed transmission—and reverse—provides power for grades and speed for straightaways.



The Scootruk is said to be especially useful for pouring floors and slabs. The edge of the bucket is 34 in. high, allowing it to be loaded at most concrete mixers without a pit or special platform. Dumping is controlled from the driver's seat or from the side of the bucket.

Air Setting Cement

A NEW AIR SETTING refractory cement, called Armstrong's Air Set, that combines all the essential engineering requirements with the maximum of practical workability required by the brick mason has been developed by the Armstrong Cork Company.

The new cold setting cement is designed for use as a bonding mortar with fire brick and insulating fire brick. It is also recommended as a protective facing for fire brick or insulating fire brick furnace linings. Air Set reduces maintenance costs because it provides a tight, permanent joint and strong bond that does not allow brick to become loose in the wall and protects the furnace lining.

Among the outstanding features of Air Set is its maximum workability and high plasticity. It pours readily from the drum and is easy to thin with water to dip joint or facing consistency. In the mortar box, Air Set remains in suspension even when thinned, and one mixing provides a uniform consistency of mortar. For more details contact Armstrong Cork Company, Lancaster, Pa.

FASTER CUTTING ...with Clipper Masonry Saws

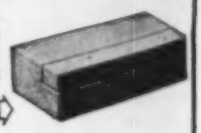
Your Special Size and Shape Brick or Concrete Block can now be "Tailor-Made" at a moment's notice!

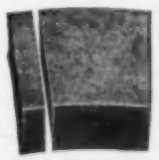
The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

Here are a few typical examples of the speed and accuracy with which concrete products and fire brick can be cut.

This concrete block, converted into a special size, was cut completely in two in 19 seconds.

One of the many intricate cuts performed on first quality clay brick for heat treating furnaces —made in 8 sec.





Rotary Kiln Blocks, cut to size for "key" bricks in rotary kilns, require only 10 sec. for completion of cut.

Basic refractories for steel furnaces or cement kilns must be accurately installed. This magnesite brick was cut in 12 seconds!

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design and build
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for safe protection
on any high pressure
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Pipe Repair Clamp

A NEW CAST BRONZE full circle repair clamp so simple that one man can install it in six minutes, is announced by the Smith-Blair Company of South San Francisco, California. Installation requires the simple bolting together of the two halves of the coupling over the broken or split cast iron or cement-asbestos pipe. The use of bronze for the coupling and duronze nuts and bolts assures the permanence of the repair, it is said.

One of the most unique features of the new Smith-Blair clamp is the manner in which it forms a complete water-tight circle that compensates expansion and contraction of the pipe. Special molded rubber gaskets with copper armor are bonded to the inside of the coupling sleeves so that the fingers may slide easily over the gaskets until they overlap to form a full wrap-around. Thus, the rubber gasket cannot wrinkle or gather under the coupling. The result is a complete, strong encirclement with pressure so well equalized that even weak-walled pipe are not crushed.

Tests show that the coupling, in the 4" diameter size will hold 1,000 pounds of hydrostatic pressure.

Continuous Dry Material Weighing

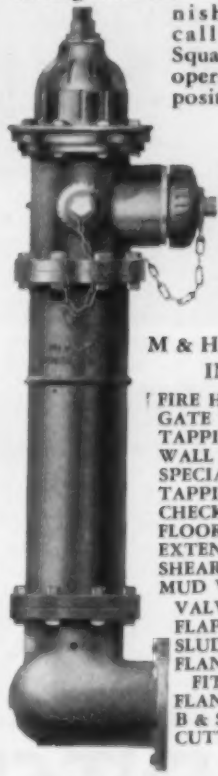
A NEW DEVELOPMENT in the continuous weighing of dry materials on Conveyor belts is offered by Builders-Providence, Inc., of Providence, R.I., in the Conveyoflo Meter. This meter utilizes diaphragms instead of the usual knife-edge-beam principle for metering flow of dry materials by weight. Bulky overhead framework, scale beams, knife edges, tie rods, etc., are eliminated, and for this reason the Conveyoflo Meter is a much simpler unit and occupies less space than the usual conveyor scale.

Industrial processes will benefit by the efficiency and high accuracy of the Conveyoflo Meter. These processes may involve continuous weighing of such materials as coal, gravel, stone, powdered chemicals, ore (newly mined and crushed), and sewage sludge. The scales may be used to proportion and control, as well as weigh, the feed of one or more dry materials such as cement, sand and gravel, ground rubber for reclaiming operations, batching of wood chips to digesters and controlling ore to ball mills; and to control the flow of liquids in proportion to the flow of dry materials. The weighing section of the Conveyoflo Meter is supported at one end by self-aligning ball bearing pillow blocks, and at the other end "floats" on a diaphragm which transmits load changes hydraulically to the weighing mechanism. The cyclometer type totalizer reads directly in any unit desired, and is non-cyclical in operation, employing the time-proved disc-and-wheel integrating principle, and is automatically corrected for any belt speed variations.

Integration is automatically compensated for variations in belt weight and for adherence of material to the belt, through a system of return belt weighing. For further details, write directly to manufacturer.

M&H
HYDRANTS
& VALVES
Pipe Line Accessories for Water Works and Sewage Works
Write for Catalog No. 34

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.



HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals.

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MUD VALVES
VALVE BOXES
FLAP VALVES
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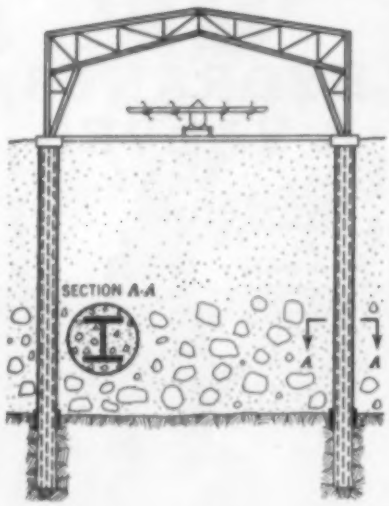
M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

DRILLED-IN-CAISSON FOUNDATIONS FOR HANGARS



are anchored in Rock Sockets . . .

These patented foundations are designed for heavy loads up to 1500 tons on a single caisson and can be sunk to great depths through difficult ground.

Send for catalog and reprints descriptive of jobs done.

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The before and after photos show a reservoir we re-lined with "GUNITE" in 1925 for the Village at East Aurora, N.Y. Recently Mr. V. E. Haemmerlein, Village Engineer, wrote us: "*The job you did of Guniting our reservoir is still in first class condition. Some hair cracks have developed near the top. I drilled one-half inch holes where some of these cracks showed but find that they are only about one inch deep. They do not go beyond reinforcing. We have had no maintenance whatsoever.*"

We can similarly solve your problem if you have an old leaky or disintegrated reservoir. We invite you to call on us for complete information, recommendations or estimates on any "GUNITE" work which you may be planning.

Our 72-page bulletin B-2300 describes this job and scores of other profitable uses of "GUNITE." Write for your free copy today.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.

Literature Available

AIR INLET VALVES—The first bulletin ever to contain complete data on the use of air inlet valves is announced by The Simplex Valve & Meter Co. All facts needed to put air inlet valves into use as protection against collapse of thin-walled, gravity flow pipelines are contained in the booklet, which replaces lengthy formulae, calculations with accurate nomographs, and concise details of design and operation. Copies of the bulletin, No. 125, may be obtained from The Simplex Valve & Meter Co., 6724 Upland St., Philadelphia 42, Pa.

CATERPILLAR TRACTOR CO. PROGRESS—The evolution of Caterpillar Tractor Co. and its products progress achieved to date and plans for future progress, are outlined in a newly published 12-page booklet titled "Caterpillar Progress Through the Years." Graphically illustrated, the booklet reviews the birth of heavy machinery and traces the patient strides taken to present today's efficient and productive equipment—developments which provide knowledge and experience toward meeting problems of the future. Copies of the publication may be obtained by writing Caterpillar Tractor Co., Peoria 8, Ill. Please request Form 10,000.

NEW DRAGLINE BUCKET BOOKLET—"How to Get the Most Out of a Page Automatic Dragline Bucket" is the title of a 20-page booklet just published by Page Engineering Co., Chicago, Ill. Detailed information on dragline operation makes it a veritable handbook for operators. How to select the right size and type of bucket, how the bucket operates, how to use it and care for it for maximum production, are a few of the subjects discussed and illustrated. Copies may be obtained by writing to this publication or to the company.

SPECIFICATION DATA FOR PREFABRICATED INSULATED PIPE UNITS—Designed so that it will be of great practical use to engineers and architects is a booklet of specifications for undergound pipe distribution systems employing prefabricated insulated pipe conduit. Published by The Ric-wiL Company, Cleveland, Ohio, it is a comprehensive compilation of data arranged in convenient tabular form with supplementary diagrams and charts. Typical of the information contained are tabulars of dimensions for one or more conduits in one trench, tables of maximum conduit capacities of wrought iron and steel pipe sizes, and standard prefabricated expansion loop details. Loop dimensions expansion charts for both steel and wrought iron pipe are shown in convenient and usable form. Construction details of Ric-wiL insulated pipe units and available accessories are also given. Copies of the booklet may be obtained without charge by writing The Ric-wiL Company, Cleveland, Ohio.

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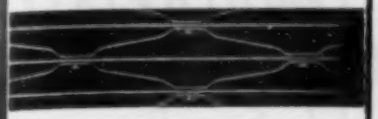
FLOORING AND STAIR TREADS

"A Fitting Grating for Every Purpose"



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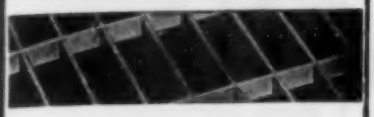

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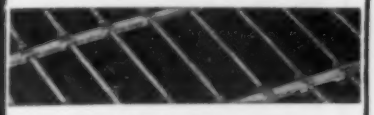

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SPIRAL TUBE USES—A new booklet describes and illustrates uses for a spirally formed, lightweight tubing. A four-ply "backbone" construction makes the tubing sufficiently rigid for use as stacks, stack-liners, and flues. It is cheap enough to be used as forms for concrete pillars, posts, and piers. One man can carry 60 ft. of the tubing 20-ft. lengths and, on portable irrigation work, can lay several thousand feet a day. Copies of the Bulletin, entitled "Big New Economies for Pipe and Tubing Users," from Pratt Industries Inc., Frankfort, N.Y.

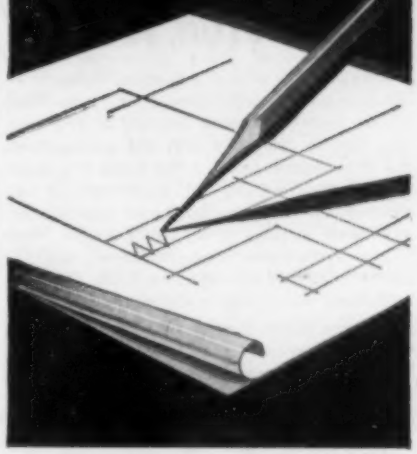
ONE MAN BRIDGE RAMP—A new folder describing the "One Man Bridge Ramp" is announced by the Elizabeth Iron Works. The "One Man Bridge Ramp," is designed for use with fork trucks on railroad sidings, has a load capacity of 15,000 pounds and can be placed and secured by one person in less than two minutes. No physical lifting is required. Transported to location between platform and freight car or between two freight cars on the forks of any standard fork lift truck, the ramp is set into place and forks withdrawn. Lift handles drop into place providing a flush riding surface. Locking pins firmly secure the "One Man Bridge Ramp" in place. An accompanying survey and specification sheet is so simplified that any person who is familiar with the movement of materials handling mechanically may select the correct size and type of ramp to fill his requirements. A copy of this folder and survey sheet may be obtained by writing to the Elizabeth Iron Works, P.O. Box 360, Elizabeth B, N.J.

SUCTION HOSE—A catalog section on its suction hose for sand and gravel service, as well as the Armorite dredge sleeves for flexible connections on discharge pipe lines, has just been issued by The B. F Goodrich Company, Akron, Ohio. Both products are used on suction dredges and similar severe service.

CLAY PRODUCTS—Designed to aid builders, engineers, plumbers, public work planners, and building and supply dealers in need of quick service for clay products, a bulletin recently issued by The Robinson Clay Product Co. of Akron, Ohio, carries dimensions and specifications of sizes and fittings of various clay products widely used. It may be obtained, free of charge, by writing to The Robinson Clay Product Co. at Akron for bulletin R-846-11.

BULK CEMENT CONVEYING—The Fuller Company, Catasauqua, Pennsylvania, offer a new 24 page booklet, FK-20, describing "Bulk Cement Conveying With Fuller Equipment." In this attractive two-color booklet, the many uses and specifications of Fuller equipment are set forth. Copies may be obtained by writing direct to the company.

TRACING CLOTH for HARD PENCILS



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Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

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DOWN IN WARRINGTON, FLORIDA

Back in 1937, when the Peoples Water Service Company bought their first Layne Well Water System to serve the city of Warrington, Florida, they had only 263 connections. But Warrington, being a fine home city, grew larger and larger. By 1941 a second unit was needed, and being guided by an appreciation of known quality, none but a Layne Well Water System was to be considered. In 1945, connections had increased to 3,200, so again additional water supply was needed.

Peoples Water Service Company now have their third Layne Water System . . . one of the finest and most complete in the entire state. Powered with a 100 h.p. electric motor, turning at 1170 r.p.m., this new system is producing 1150 gallons of water per minute. The well is underreamed and packed with 20 yards of sized gravel.

Standardization on Layne Well Water producing equipment, was a very wise move. Production cost of water is exceptionally low and dependability of equipment is a major asset.

For further information on Layne Well Water developing service, address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

LAYNE PUMPS **for lakes, rivers, reservoirs, irrigation, for any use where large quantities of water must be produced at low cost. Sizes range from 40 to 16,000 gallons per minute, powerd by electric motor, V-belt or right angle gear drives. Write for Layne Pump Catalog.**

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PERMACOTE ASPHALT—The Berry Asphalt Co., 120 S. La Salle St., Chicago, has just published a book on their revolutionary new asphalt, Permacote, "The Asphalt That Defies Water." The book is lithographed in two colors and is profusely illustrated with charts, graphs, etc. It was written from the point of view of both the engineer and contractor and contains material that is highly technical as well as explanatory matter about its numerous advantages for practical use. While edition of this book is limited, the Berry Co. states they will send a copy to engineers and contractors on request.

LATEST MODEL REHANDLING BUCKETS—Lighter than most other buckets of similar size and rating, the latest Hayward E-16 Rehandling Clam Shell Bucket makes definite economies possible by its ability to handle bigger loads with smaller bucket weight. This is one of the many features and details described in a revised Bulletin, No. 697, just issued by the manufacturer, The Hayward Co., 50 Church St., New York 7, N.Y. Of interest to cost-conscious rehandlers of sand, gravel, crushed stone, cement clinker and other bulk materials, this well-illustrated bulletin also shows how the Hayward E-16 Bucket can be adapted as well for excavating, mud work, dredging, and other services. A chart lists bucket load capacities, weights, and dimensions in terms of various materials handled, together with figures on recommended wire rope diameters, reeving, and closing lengths. Copies may be obtained by writing direct.

NEW SUBMERSIBLE PUMP BULLETIN—The Pump Division of Byron Jackson Co., Los Angeles, has just released a new 12-page Bulletin (No. 46-5000) on their deepwell turbine pump and electric motor unit known as the "Submersible Pump," a motor pump unit that operates entirely submerged in water at any depth, for pumping applications requiring capacities of 7,000 gpm to 20,000 gpm and heads to 1,500 feet. Printed and illustrated in three colors with photographs, parts diagrams and tabular data, the Bulletin covers specifically Submersible Pumps Type "B" for relative low capacities, high head operations; "K" for general deepwell applications; and "R" for relatively high capacities, low head operations. Photographs of applications in a flood area near the town of Oceanside, California, the city of Inglewood in that same state, a large bakery, a mine unwatering application and a film studio stress the "out of sight" feature of the Submersible. Copies will be sent upon request. Address Bulletin Dept. 46-5000, Byron Jackson Co., Box 2017 Terminal Annex, Los Angeles 54, California.

ROYLYN CATALOG—A new 20-page catalogue and reference information digest of Roylyn, Inc., containing engineering data and specifications on its quick couplings, caps, and allied products, is now available to manufacturers and users. For your copy write to Roylyn, Inc., 718 W. Wilson Ave., Glendale 3, Calif.

Polaroid*... Photoelastic Polariscope

for Stress Determination

For either qualitative or quantitative photo-elastic analysis, perfection in the projection lens system is of major importance.

In our new model polariscope of 4¼" clear aperture, the parallel beam is collected by a rear element and condensed through a three component lens of the Cooke system. In the new larger unit (8¾" aperture) a four component lens of the Omnar system is used. *The image is sharp throughout the field, free of aberration, astigmatism, and distortion.*

Literature of new model polariscopes now available

POLARIZING INSTRUMENT CO., Inc.
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"COMMERCIAL" *Improved Tunneling Practice*

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the solid corner flanged plate. Designed to eliminate excess excavating and concrete. Easy to install, using any type of tunnel driving—and made to any radius from 3¾ feet up. Circular, horseshoe or egg shape.

This is the plate engineers should specify in ordinary tunnel or sewer jobs.

Details on the use of this plate gladly given.

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